SCIENCE ABSTRACTS.

Section A.—PHYSICS.

FEBRUARY 1925.

GENERAL PHYSICS.

243. *The Time Service of the Paris Observatory.* **G. Bigourdan.** (Bull. Astronomique, 3. 4. pp. 435–516, 1923.)—For previous part see Abstract 1646 (1924).

244. *The Density of the Oxides of Zirconium and Hafnium.* **J. Hevesy** and **V. Berglund.** (Chem. Soc., J. 125. pp. 2372–2375, Nov., 1924.)—The analysis of a mixture of the two elements can be carried out easily and quickly by measuring the density of the mixture of their oxides; hafnium dioxide is nearly twice as dense as zirconium dioxide, so that the method is fairly sensitive. The density of zirconium dioxide has been found to vary between 5·45 and 5·89. The variations are most probably due to the presence of variable amounts of amorphous matter, or possibly to hollow spaces or air enclosures in the oxide powder. The author shows that by always preparing the oxides by exactly the same method reproducible values are obtained, which can be used to estimate the proportions of the two substances in a mixture. H. N. A.

245. *Apparatus for Viscosimetric Determination of Transition-Points.* **N. H. Hartshorne.** (Chem. Soc., J. 125. pp. 2096–2099, Oct., 1924.)—Instead of preparing saturated solutions at different temperatures and measuring their times of flow in a viscosimeter of the Ostwald type, successive solutions are prepared in one and the same vessel, thereby effecting a considerable saving of time. This was done by using a capillary pipette, with paddles attached to the end as a stirrer, so that samples could be drawn up into the bulb and the time of flow through the capillary measured by merely stopping the stirring, without removing the solution or the pipette from the thermostat. T. M. L.

246. *An Instrument for Measuring the Swelling of Gelatine on Rigid Supports.* **S. E. Sheppard** and **F. A. Elliott.** (Eastman Kodak Co. Research Lab., Comm. No. 203. Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 181–184, Aug., 1924.)—In studying the behaviour of the gelatine film on photographic plates, etc., during the processes of development, hardening, etc., it is necessary to follow the swelling of the film as a function of time of immersion without removing the plate from the dish and without interfering with the process. For this purpose the instrument described in the paper has been devised, based on the principle that gelatine films attached to rigid supports, such as glass plates, swell only in the direction of their thickness. The instrument consists of a balance beam pivoted on a vertically mounted stage micrometer. From one end of the beam hangs a silica rod, the foot of which rests in equilibrium on the surface of the film to be tested, the film being rigidly held in a suitable dish. The opposite end of the beam carries a counterpoise. As swelling proceeds the beam is tilted and is restored to the initial position by raising the micrometer; the difference in readings gives the swelling in a given interval of time. The null position is accurately obtained by viewing in an eye-piece the images of an illuminated slit reflected from small mirrors fixed to the ends of the beam. The agreement between the swelling measured by the instrument and that found by gravimetric methods is very satisfactory. B. H.

247. *A Curvature Gauge.* **C. K. Wentworth.** (Optical Soc. of America, J. & Rev. Sci. Inst. 9. pp. 341–343, Sept., 1924.)—Describes a curvature gauge used for pebbles and cobbles and accurate to within 5 % from 1 to 100 mm. radius of curvature. A block is shaped to a cuspate curve designed to give a uniform percentage accuracy on the scale. This slides in a straight line until the object to be measured just touches both sides of the curve and also a straight edge inclined at a small angle to the direction of travel. The curvature is measured by the position of the block along the straight edge. E. G.

248. *On the Use of the Recknagel Disc as an Indicator of Speed and Direction.* **A. Foch.** (Comptes Rendus, 179. pp. 592–594, Sept. 29, 1924.)—The apparatus proposed by Recknagel for measuring the speed of a fluid current is described in detail, together with a series of experimental determinations made with the disc at varying angles to the current direction. H. H. Ho.

249. *Improvements in Aneroid Barometers and Barographs.* **E. Becker.** (Meteorolog. Zeits. 41. pp. 306–309, Oct., 1924.)—The main features of existing types are summarised and their usual sources of error indicated. A new type of aneroid barometer is described in which a metal box of special shape is closed at the top by a ribbed diaphragm. At the centre of the diaphragm is a metal plate, to the lower surface of which is fixed a helical spring, which just reaches to the bottom of the box. On the upper surface of this plate rests the knife edge of a small piece of agate carried by the index arm. The movement of the diaphragm is opposed by the spring and a very exact elastic after effect is obtained with an absence of zero errors. The effects of temperature are very small and the results of tests at the Reichsanstalt are given. The same principles were adopted for a registering barograph for use on aircraft in height determinations. The usual barograph boxes of ribbed metal were arranged in two groups of five each and inside each such group a control spring was arranged. The effect of temperature is largely eliminated in that the changes for the two groups are opposed to one another. Curves are given which show the results obtained for two such barographs and very good agreement results, while at the same time a considerable improvement is shown on previous types of these instruments. R. S. R.

250. *Electrical Time-Marking System for Self-Recording Meteorological Instruments.* **L. H. G. Dines.** (Roy. Meteorolog. Soc., J. 50. pp. 373–380, Oct., 1924.)—The arrangement used consists of a central clock capable of completing an electric circuit at minute or hourly intervals and electromagnets operating mechanisms on the various instruments. The clock movement is bolted to an iron bracket built into the wall to give a solid foundation. The clock case is fixed separately and consequently the hanging of the pendulum is unaffected when winding up the clock. The seconds hand carries a Pt pin dipping into a drop of mercury covered with glycerine and contact is made for 3–4 secs. each minute. The minute hand closes a very light Pt contact for about 30 secs. each hour. A special pattern of electromagnet was employed and different methods were used to connect the movement of the armature with the moving part of several different recording instruments, some of which required much larger forces to actuate them than others. R. S. R.

251. *Bibliography for Measuring Instruments, with Special Reference to Instruments and Methods of Metrology used in Mechanical Engineering.* **F. J. Schlink.** (Optical Soc. of America, J. & Rev. Sci. Inst. 9. pp. 309–321, Sept., 1924.)—A useful bibliography of the literature classified under the following heads: 1. General Material, Theoretical or Basic, on Physical and Mechanical Instruments. 2. Measurement and Production of Small Linear and Angular Displacements and Distances. 3. Theory and Measurement of Vibrations; Measurement of Speeds and Time Intervals. 4. Frictional and Other Types of Hysteresis and their Relation to Instrument Design and Testing; Accuracy, Sensitivity and Variance. 5. Dynamometers—Measurement of Force (except Weighing Scales), Torque and Accelerations. 6. Measurement and Control of Temperature and Humidity. 7. Weighing Scales. 8. Pressure Gauges, Manometers, Aneroid Barometers. 9. Engine Indicators. 10. Properties and Design of Springs. 11. Miscellaneous Instruments. E. G.

252. *Apparatus for Investigating Certain Types of Fluid Motion.* **E. N. da C. Andrade and J. W. Lewis.** (Journ. Sci. Instruments, 1. pp. 373–377, Sept., 1924.)—Describes, with photographs and diagrams, the construction and use of an apparatus to show the phenomena discovered and investigated by G. I. Taylor in a recent paper [Abstract 1518 (1923)], namely, the way in which the liquid between two rotating cylinders moves, when the velocity exceeds a certain minimum, in helical vortices. The present apparatus is on a much smaller scale than Taylor's. The internal cylinder is a rod of silver steel 5 mm. in diam., the outer a glass tube 10 mm. internal diam. and 170 mm. long. The outer cylinder passes through a cubical glass block, with a very small clearance, and the space between is filled with a liquid of the same refractive index, so that the distortion due to refraction is absent, and consequently photographs can be taken from which actual measurements of velocity, etc., can be obtained. For this purpose a flat beam of light is used, and liquid containing particles of colloidal silver in suspension is employed. Experimental results and photographs are promised elsewhere. W. G. B.

253. *A New Drift Indicator.* **J. N. Carruthers.** (Nature, 114. pp. 718–719, Nov. 15, 1924.)—An instrument for determining in connection with fishery problems the residual currents in the water. In the instrument there are a set of cups which rotate when it is lowered into the sea. These are connected through certain gearing which releases phosphor-bronze balls from a hopper, and allows the balls to roll down a groove on a specially pivoted magnet and so into a divided chamber. This chamber during the course of observations is orientated according to the current, the whole instrument being kept "in the current" by means of a vane. The hopper holds some thousands of balls. The sectors in the divided compartment are 20° and by the use of ordinary traverse tables it is easy to resolve the values (number of balls) along the four cardinal directions and to find the magnitude and direction of the residual current if the "mileage value" of the balls be known. In the present instrument calibration against log-ship observations showed that twenty-four balls were dropped for each mile of water that passed the ship. E. G.

254. *Chronometer Spirals with Pinching Pieces (Vetterlein System).* **H. Bock.** (Zeits. Instrumentenk. 44. pp. 410–416, Sept., 1924.)—A mathematical investigation. A. D.

255. *Effect of Length on Skin Friction of Flat Surfaces.* **T. E. Stanton** and **Dorothy Marshall.** (Inst. Naval Architects, Trans. 66. pp. 214–219, 1924. Engineering, 117. pp. 718–719, May 30, 1924.)—An experimental investigation, carried out at the National Physical Laboratory, is described, from which it is concluded that, as regards the effect of length of a plane surface moving in a fluid, skin friction cannot be taken to be dependent entirely on the relative velocity of the surface and the fluid in its immediate vicinity, unless accompanied, as suggested by Froude, by some mechanism by means of which the particles of fluid are supplied to the surface at a rate which increases as the distance from the leading edge. Such a mechanism is in agreement with the result of recent investigations which point to the existence of a coefficient of eddy viscosity increasing in value with the lateral extent of the disturbed motion. The result of this action is that frictional wake may be regarded as having practically no effect on skin friction. The results obtained lead to the further general conclusion that in the experimental study of the friction of rectangular surfaces which are relatively long in the direction of flow, the effect of lateral dimensions of the surface on the mean intensity of friction cannot be neglected, and that strict geometrical similarity in the models is desirable. J. V. H.

256. *Boundary Lubrication: Influence of Composition of the Solid Face.* **I. Doubleday.** (Roy. Soc., Proc. 106. pp. 341–346, Sept. 1, 1924.)—The coefficients of friction for clean faces and for faces flooded with normal paraffins, primary alcohols, and fatty acids were determined for four types of steel, namely, 50-ton alloy steel, nickel-chrome steel, medium carbon steel, and mild steel, and one sample of phosphor bronze. The coefficients for bronze on the first three types of steel are also given. The results given show that definite relationships exist between the differences in the coefficients of friction for a lubricant of a particular molecular weight when both surfaces are of one metal and both are of another metal, for the different types of lubricants. It was observed that the solids which gave the lowest values of μ were those which were most torn by the sliding of the surfaces over one another, and from a microscopic examination of the faces it appeared that, arranged in order of decreasing wear and tear, the solids were also in order of increasing μ. An attempt to correlate friction with hardness was not successful. [See also Abstract 249 (1923).]

C. O. B.

257. *Measurement of the Effectiveness of Lubricating Oils.* **R. v. Dallwitz-Wegner.** (Zeits. techn. Physik, 5. 9. pp. 378–384, 1924.)—The effectiveness of a lubricant depends on its power of wetting the metal surface of the bearing. As this capacity differs with different metals, the latter have also to be taken into account in estimating the properties of a lubricant. Apparently the wetting capacity increases with the ratio of compressive strength of the metal to that of the lubricant. The determination of the latter quantity involves a knowledge of the molecular weight and the volumetric modulus of elasticity. A simpler method of estimating the effectiveness of a lubricant will be described later.

S. L. S.

258. *The Dependence of Surface Tension on Density and Temperature.* **W. L. Lewschin.** (Zeits. phys. Chem. 112. pp. 167–174, Sept. 20, 1924.)—An expression is derived connecting the results of Ramsay and Shields for the surface tension of liquids and the results of Young for the density of the liquid and the vapour density by employing the method of least squares. This has the form for non-associated liquids $a = K(T_K - T)^{\frac{1}{2}}(\Delta - \delta)^{2 \cdot 36}$ where a = surface tension, K = a constant, characteristic of the liquid, T = temperature, T_k = critical temperature, Δ = density of liquid, δ = density of vapour. Very good agreement is obtained between the observed and calculated values of a for seven liquids of varying types. For temperatures remote from the critical temperature, δ may be neglected, and therefore from the equation above the relationship $\frac{a^2}{\Delta^{4 \cdot 72}} = K_1(T_k - T)$ should hold. This is shown to be the case by graphical methods for eight liquids where the necessary conditions hold. A further development of the above expression introducing molecular proportions yields a relationship which should be constant for all liquids. This is found to be true for the liquids studied, *i.e.* benzene chloro-benzene, ethyl acetate, methyl formate, ethyl ether, carbon tetra-chloride and carbon dioxide.

(**Errata**, *ibid.* 113. p. 336, Nov. 8, 1924.) B. W. C.

259. *Surface Tension of Tetralin, Dekalin and Spindle-Oil.* **L. Grunmach** and **G. Schweikert.** (Zeits. phys. Chem. 113. pp. 432–440, Nov. 20, 1924.)—The values found were tetralin 3·493, dekalin = 3·210, spindle-oil = 3·171 mg./mm.

T. M. L.

260. *Surface-Tension and Density-Difference.* **G. N. Antonoff.** (Zeits. phys. Chem. 112. pp. 461–466, Sept. 30, 1924.)—According to D. B. MacLeod [Abstract 190 (1924)] and A. Ferguson [Abstract 729 (1924)] the surface-tension of a liquid may be written as $a = k \, . \, \Delta^4$, where k is a constant and Δ is the difference between the liquid density and the saturated-vapour density. The author finds that no formula with a single constant is adequate; and comes to the conclusion that no formula to cover a wide range of temperatures can be found, on account of changes in the structure of the liquid which cause discontinuities in the experimental curves.

A. D.

261. *Tenacity of Zinc by Cold Treatment.* **G. Masing** and **M. Polányi.** (Zeits. f. Physik, 28. 3 and 4. pp. 169–176, 1924.)—The physical tenacity of zinc freshly worked at 85° K. amounts to 45 kg./mm.^{2} and is much higher than that of zinc at a red-heat. The tenacity of fine-grained material with grains about 80 μ^2 reaches 15 kg./mm.^{2} and is higher than that of the coarse-grained, which with grains about 50,000 μ^2 shows a tenacity of 5 kg./mm.^{2}.

The tenacity of polycrystalline zinc is always higher than that of the single crystal. E. H. B.

262. *The General Solution of the Problem of Static Elasticity.* **G. Somigliana.** (Accad. Sci. Torino, Atti, 59. 5, 6 and 7. pp. 91–102, 1923–1924.)—The problem of the equilibrium of elastic structures leads to a system of differential equations which, in the case of isotropic bodies, assume a very simple form, the general solution of which is the purpose of the present article. Owing to its mathematical nature the article cannot be suitably abstracted and should be consulted. E. B.

263. *The Equilibrium of Elastic Lattice Structures.* **O. Sesini.** (Accad. Sci. Torino, Atti, 59. 11–12. pp. 195–202, 1923–1924.)—If the elements of a lattice structure are supposed to be elastic so that their lengths vary in proportion to the stresses acting upon them, it is demonstrated in this article that the solution of the problem is unique and well determined subject to the condition that the possibility of equilibrium exists in the case of non-elastic elements. This problem is treated analytically, so that the original article should be consulted. E. B.

264. *Contribution to the Theory of Elastic Distortions.* **P. Bonnano.** (Accad. Sci. Torino, Atti, 59. 8–9. pp. 126–130, 1923–1924.)—The author analyses three types of distortions, known respectively as the distortions of Volterra, of Somigliana and of Colonetti. He shows that from the analytical point of view it is easy to establish a characteristic relation between these types of elastic equilibrium. The treatment is mathematical. E. F.

265. *Application of Variational Equations to Statical Problems of Elasticity.* **A. Ono.** (Kyushu Univ. Coll. Eng., Mem. 3. No. 2. pp. 87–116, 1924. In English.)—The various conditions in which strain-variational and stress-variational equations are applied, with particular attention to the latter, are considered in detail and the results of calculations are compared with actual experiments, deflections being observed on steel specimens of rectangular sections, with particular attention to the end conditions. The calculated values for deflections are found to be greater than the observed values for moderate loads, but the differences decrease with increased load, and finally the calculated values are found to be smaller than the observed values with high loads. This is probably accounted for by the fact that the modulus of elasticity was assumed to be constant throughout the whole range of stresses. C. O. B.

266. *On a Special Case of a New Type of Elastic Distortion appertaining to Certain Practical Problems.* **P. Bonanno.** (Accad. Sci. Torino, Atti, 59. 11–12. pp. 179–187, 1923–1924.)—If several tubes be forced one over the other, each having an initial external diameter slightly greater than the initial internal diameter of the one which is to enclose it, the system of tubes thus obtained shows a state of internal tension such that the circular fibres of the inner tube are compressed and those of the outer tube stretched. The fibres of the intermediate tubes will thus be partly stretched and partly compressed, proceeding from the exterior to the interior. This state of internal tension depends solely on the difference between the initial radii of the cylindrical surfaces which are to be brought into perfect contact. With a view to its practical utility in various technical processes, notably in the construction of artillery, the author proceeds to establish mathematically a criterion which shall serve as a basis for the direct estimation of the tensions and compressions developed in the various tubes as a function of the difference in the radii. E. F.

267. *On Strains in Ships' Hulls.* **G. M. Pugno.** (Accad. Sci. Torino, Atti, 59. 13. pp. 264–271, 1923–1924.)—Entirely mathematical. E. F.

268. *The Diagram of the Air-Pressure in the Static Calculation of Aeroplanes.* **G. Albenga.** (Accad. Sci. Torino, Atti, 59. 14. pp. 305–308, 1923–1924.)—Review of various attempts to find a mathematical formula which shall bring aerodynamic theories into agreement with experimental results. The problems are worked out by a series of curves. E. F.

269. *On the Extinguishing of Vortices in a Viscous Incompressible Fluid in Plane Motion.* **C. Pasqualini.** (Accad. Sci. Torino, Atti, 59. 14. pp. 293–303, 1923–1924.)—In investigating the motion of perfect fluids the potential function is excluded, and only the function of current can be advantageously employed in the case of plane motion. When its form is not too complicated, it leads to results more general than those obtained either by purely analytical methods of approximation or by accepting physical simplifying hypotheses. In considering the problem of the extinguishing of vortices formed by any cause in a viscous incompressible fluid in plane motion, having previously found a special form suitable for representing by Fourier's integral any function of current at the initial moment, we obtain from this the form of the function of current at any subsequent moment, and therefore all the elements of the motion. The problem has been solved by Terazawa, of Tokyo University, but without employing the function of current and in the special case of a symmetrical disposition of infinite rectilinear vortices about an axis, and by various English and American authors in the case of an isolated vortex. The author's investigations tend to show that the law of cyclones known as Okada's law is theoretically justified. The treatment is mathematical. E. F.

270. *On Some General Properties of the Plane Motions of a Liquid.* **D. Riabouchinsky.** (Comptes Rendus, 179. pp. 881–883, Nov. 3, 1924.)—This entirely mathematical paper first deduces the equations of irrotational motion from the rotational. The equation of pressure is next derived in terms of the velocity of displacement of the point of intersection of a current and an equipotential line. The general case of non-permanent and permanent rotational motion is then examined and extended to permanent irrotational motion. Finally the undulatory rotational motion of Gerstner receives definition. H. H. Ho.

271. *The Damping of Torsional Vibrations in Air at Reduced Pressures.* **R. V. Wagner.** (Phil. Mag. 48. pp. 847–859, Nov., 1924.)—The logarithmic decrement of a hollow aluminium cylinder, suspended by a bifilar suspension between two concentric brass cylinders, with air gaps of about 2 mm., was measured at different pressures. A very small piece of magnetized watch-spring was attached to the small mirror by means of which the deflections were measured, and the oscillations were started by means of a magnet; the suspension was adjusted so that, when the system was at rest, the torques due to the suspension and to the attached magnet were both zero. At low pressures, when the mean free path is comparable with the distance d between the fixed and moving cylinders, there will be slip, for which allowance must be made, and the logarithmic decrement λ will no longer be proportional to the coefficient of viscosity μ. Low pressures were obtained by means of a Fleuss-Geryk oil-pump and a charcoal tube cooled in liquid oxygen, which gave a more constant temperature than liquid air. A manometer and McLeod gauges with bulbs of 30 c.c. and 500 c.c. capacity were used, the latter for pressures below 0·015 cm. When the outer brass cylinder only was used the decrement fell off quite decidedly from 76 cm. to about 30 cm. Hg. This effect was noticed by Crookes, for all gases except hydrogen. Between 30 cm. and 1·5 cm. the decrement is constant, then falls off slowly to 0·15 cm. and more rapidly afterwards. At about 0·015 cm. the mean free path is approximately d, and the decrement falls off very rapidly. In the logarithmic decrement against log p curve there is a point of inflexion, and the decrement appears to approach a constant value, about 0·05 of its value at atmospheric pressure; this residual damping is due to friction in the silk fibre, etc. Similar results were obtained using both cylinders. When the mean free path is greater than d collisions between the molecules are infrequent, and they travel to and fro between the cylinders, reducing the angular momentum of the oscillating cylinder. The loss of momentum is proportional to the number of molecules, *i.e.* to the pressure, and to the mean molecular velocity, which is constant if the temperature is constant. The experimental result agreed with this theory. H. N. A.

272. *The Influence of the Air on the Oscillation Period of the Pendulum.* **H. Bock.** (Zeits. Instrumentenk. 44. pp. 431–442, Oct., 1924.)—This paper considers the different disturbances due to variations of air-density on the pendulum period by an investigation first of the individual effects and then generally from the standpoint of hydrodynamics. Five different influences are examined, *viz.* aerostatic, aerodynamic, viscosity, variation of amplitude, and indirect temperature disturbances. A rigid hydrodynamic investigation of a case with the simplest boundary conditions has enabled the aerodynamic and dissipative disturbances to be comprehended in a single scheme. [See also Lamb's Hydrodynamics.] For the other factors separate expressions are derived. The paper is entirely mathematical. H. H. Ho.

273. *Propagation of Elastic Waves along the Boundary of Two Solids.* **R. Stoneley.** (Roy. Soc., Proc. 106. pp. 416–428, Oct. 1, 1924.)—A mathematical investigation of the conditions of propagation of waves of the Rayleigh and Love types along a plane welded surface of separation of two solids. Waves of the Rayleigh type are shown to be possible in both compressible and incompressible media so long as the wave velocities in each do not greatly differ. The case of Love waves in a stratum bounded by two infinite solids is also considered. If the stratum is very thin, waves of this type do not exist. A. Wh.

274. *Some Relativistic Problems of Rotation.* **T. Takeuchi.** (Phys. Math. Soc. Japan, Proc. 6. pp. 14–27, Feb., 1924.)—Employing the method of tensor analysis, the author extends Thirring's work [see Abstract 449 (1918)] to investigations (1) of the influence of the uniform rotation of a thin rigid circular ring about an axis perpendicular to its plane on the motion of point-masses situated either very near the centre or far outside the ring, and (2) of the influence of the uniform rotation of a solid rigid sphere about a diameter on the motion of point-masses outside the sphere. The respective values of gravitational potentials $g_{\mu\nu}$ being expressed in the form $g_{\mu\nu} = -\delta_{\mu\nu} + \gamma_{\mu\nu}$, in which $-\delta_{\mu\nu}$ denote the Galileian values, the author deduces expressions for the $g_{\mu\nu}$ and $\gamma_{\mu\nu}$ in terms of the radius of the ring or sphere, its mass and angular velocity, the velocity of light and the gravitational constant. The effects produced by the rotation of the sun or of Jupiter upon the path of a ray of light passing by their respective edges are shown to be too small to be observable. An expression is deduced for the deflection of the path of a freely falling body owing to the rotation of the earth. J. S. G. T.

275. *The Effect of a Hole in a Bent Plate.* **W. G. Bickley.** (Phil. Mag. 48. pp. 1014–1024, Nov., 1924.)—In a recent paper [see Abstract 182 (1920)] the effect of a circular hole in a tension member on the distribution of stress is studied experimentally, and it is found that the stresses are considerably enhanced (to about three times the average) at points on the boundary of the hole. In an appendix, a mathematical investigation, limited to the case of an infinitely wide plate, is given, and the experimental results are in close agreement with this, notwithstanding the use of members of finite width. The present author now investigates the stresses near a hole in a bent plate, since similarly enhanced values of the stresses are to be expected, and an indication of their amount has now been obtained. Diagrams are included showing relative and true contours near a hole in a plate bent anticlartically and into a cylinder. The paper is entirely mathematical. H. H. Ho.

276. *Application of the Ballistic Principle for the Velocity of Light to the Doppler Effect.* **M. la Rosa.** (Accad. Lincei, Atti, 33. ii. pp. 5–10, July, 1924.)—This is a brief note in continuation of previous arguments on the ballistic principle [Abstract 2903 (1924)], and is in particular a reply to a note by W. de Sitter in the Astr. Inst. of the Netherlands, Bull. [Vol. II. No. 57. p. 121, May 31, 1924]. The paper shows both mathematically and by reference to astronomical examples that the ballistic theory is in agreement with the various aspects, etc., of the Doppler principle. Reference is made to the relativity theory, and the controversy is advanced one stage farther. S. G. B.

277. *Relations between Antisymmetric Tensors and Tensor Densities.* **P. du Val.** (Phil. Mag. 48. pp. 917–927, Nov., 1924.)—To obtain a notation for products of linear tensors independent of the summation convention and the position of the suffixes, the author defines three groups of products of pairs of linear tensors, and names them respectively as progressive, scalar, and regressive Grassman products. He then establishes the relations referred to in the title. Their chief interest lies in the fact that they reintroduce into electrodynamics that similarity between electrical and magnetic phenomena which does not fully appear in the usual tensor statement of the laws. G. W. DE T.

278. *Simple Cases of Orbital Motion governed by Inverse Square Law.* **A. Forster.** (Schweiz. Elektrot. Verein, Bull. 15. pp. 550–567, Nov., 1924.)—The author's reluctance to accept the recent proposal made by J. J. Thomson that the inverse square law should be modified led him to investigate certain simple cases of pendular and revolving motions in an elliptic path, at one of whose foci was placed an attractive and at the other a repelling mass. The results are applied to a model of a molecule (originally suggested by Fajans) in which an electron describes an elliptic path about a positive charge at one focus and a negative charge at the other. The focal charges are supposed to be maintained in equilibrium by a bodily rotation of the ellipse, the attraction between the charges being balanced by centrifugal force. A. H.

279. *Growth and Wasting of Crystals.* **G. Friedel.** (Comptes Rendus, 179. pp. 796–799, Oct. 27, 1924.)—Experimental proof that the two processes are essentially entirely symmetrical with one another, the general belief being to the contrary. A. D.

280. *Flow in Single Crystals.* **W. Geiss.** (Zeits. f. Physik, 29. 1. pp. 78–80, 1924.)—Revision of Schönborn's theory [Abstract 1404 (1922)] taking time into account. The velocity of flow is an exponential function of the time and the load; it is zero at the elastic limit and constant at the stretching limit. A. D.

281. *A Theoretical Calculation of the Rhombohedral Angle of Crystals of the Calcite Type.* **W. L. Bragg** and **S. Chapman.** (Roy. Soc., Proc. 106. pp. 369–377, Oct. 1, 1924.)—The edges of the rhombohedral cells, of which calcite is built up, meet at the angle 101° 55′. For a number of other carbonates this angle varies little from this value, the maximum being 103° 4·5′ for $FeCO_3$. Sodium nitrate has a very similar form. This close agreement is not fixed by the symmetry, and there must be some fundamental reason for it. The angle has been calculated theoretically. It is assumed that in calcite the electrostatic forces correspond to those between charge $+ 2e$ at the centre of the Ca atom, $- 2e$ at the centre of the O atom, and $+ 4e$ at the centre of the C atom. Forces of repulsion are assumed between these centres when the atoms approach one another closely. The crystal is supposed to be deformed, so that the distance between neighbouring atoms is not altered, and the forces of repulsion do no virtual work. A small deformation should be possible as a first approximation, without altering the potential energy of the system, so that by calculating the electrostatic energy for each configuration it becomes possible to find a value for the rhombohedral angle which makes the energy a minimum; this is the condition for equilibrium. The angle thus calculated differs by 3 or 4 degrees from the observed angle, but the calculated differences between the angles of the different substances are of the same order as the observed differences. If the distance between the centres of the O and C atoms is taken as 0·95 Å., instead of 1·25 Å., the value obtained by X-ray measurements, the calculated angles come quite close to those observed. It is suggested that this may be due to distribution of the O atom when attached to one side of a C atom. H. N. A.

282. *Crystal Structure of Mercuric Sulphide. I.* **N. H. Kolkmeijer, J. M. Bijvoet and A. Karssen.** (K. Akad. Amsterdam, Proc. 27. 5–6. pp. 390–392, 1924.)—Whereas cinnabar is hexagonal, the "amorphous" black precipitated form crystallises in the cubic system. It has the same structure as zinc sulphide. The lattice parameter is $5\cdot85 \,.\, 10^{-8}$ cm., and the radius of the atomic domain of the mercury atoms is $1\cdot51 \,.\, 10^{-8}$ cm. The density is 7·69. T. M. L.

283. *On the Theory of Cohesion Forces in Solid Dielectrics. Part II.* **J. Frenkel.** (Zeits. f. Physik, 30. 1. pp. 50–62, 1924.)—The present paper is supplementary to a previous one [see Abstract 2434 (1924)], in which a general method was developed for the calculation of electrostatic reciprocal effects between atoms (or ions) and applied to the determination of the cohesion forces in the diamond and in the binary ionic lattices of certain salts. This method was based on a simplified atomic model with circular electronic orbits, and calculations are now included for the extended case of elliptic orbits with processional movement. Very similar but hardly as good results are obtained for the diamond, but for sodium chloride much better accord with experiment has been attained. The concluding section discusses the influence of atomic polarisation upon the attraction and repulsion forces, and the possibility is indicated of a dynamic explanation of the latter associated with the quantum theory of anomalous dispersion. The paper is entirely mathematical. H. H. Ho.

284. *A Revision of the Atomic Weight of Antimony. The Analysis of Antimony Trichloride.* **P. F. Weatherill.** (Am. Chem. Soc., J. 46. pp. 2437–2445, Nov., 1924.)—Contains full particulars of the preparation of antimony trichloride by the action of chlorine on pure antimony, and its subsequent purification by heating with antimony to remove excess chlorine, and repeated distillation *in vacuo* in an all-glass apparatus. The $SbCl_3$ was dissolved in a solution of pure tartaric acid and compared with pure silver. The mean of nine analyses gave $121\cdot748 \pm 0\cdot00086$ as the atomic weight of antimony. Willard and McAlpine in 1921 found 121·77 and Hönigschmid has very recently found 121·76; the previously accepted value was 120·2. H. N. A.

285. *The Statement of the Mechanical Correspondence Principle.* **P. Tartakowsky.** (Zeits. f. Physik, 29. 5. pp. 294–305, 1924.)—Franck's investigations [see Abstract 2410 (1923)], which receive a preliminary discussion, have established the existence of the so-called inelastic impacts of the second kind, the necessity for which Klein and Rosseland had pointed out on thermodynamic grounds. Franck also determined that such impacts could not only take place between atom and electron, but also between two atoms. The object of the present paper is to find a mechanical correspondence between the Fourier development of the motion and the character of the mechanical energy transfer from system to system (without radiation) with as close analogy as possible to the

Bohr standpoint. The importance of such a statement is first raised, following which, by discussion analogous to the line adopted by Pauli, a proof is put forward for the reversibility of the quantum change at the impact between multi-periodic systems. From the fact of the preservation of the impulse moment, a conservation of the azimuthal quantum numbers has been derived. The effect of the concealed coupling mechanism at impact is regarded as that of a species of forced oscillations of oscillators. A postulate is laid down that the possible quantum change is determined by the inelastic impact, and demands a relationship between the mechanisms of the impacting systems. The paper is entirely mathematical. H. H. Ho.

286. *Stability of the Atom.* **D. N. Mallik.** (Phil. Mag. 48. pp. 884–895, Nov., 1924.)—It has been shown by Larmor that, in a permanently stable system of "electrons" (*e.g.* a system of electrons and a nucleus forming an atom), the vector sum $|e\dot{v}|$ is constantly zero, the radiation of energy in unit time being $2e^2\dot{v}^2/3c$, where $\dot{v}$ is the acceleration of an electron and c the velocity of light. These expressions are shown by the author to be deducible by direct integration of the field equation of the electron theory, and to be necessary consequences of the electron theory of dispersion. On certain assumptions it is then proved that the principle of permanent stability thus established is the necessary consequence of Sommerfeld's quantum conditions, in the case of a Bohr hydrogen atom. It appears then that the non-emission of radiation by a Bohr hydrogen atom, when the electron is rotating round the nucleus, the usual quantum conditions, and the coordinates chosen, are all consistent with the classical theory interpreted in terms of quantum ideas. A tentative attempt is made to extend the theory to more complex atoms. The paper is mathematical throughout. H. N. A.

287. *The Electric Moments of Typical Organic Molecules.* **C. P. Smyth.** (Am. Chem. Soc., J. 46. pp. 2151–2166, Oct., 1924.)—The author makes use of the methods described in a previous paper to calculate the moments of the electric doublets, due to the non-coincidence of the centres of gravity of the electrons and protons in the molecule [Abstract 1070 (1924)]. The quantities made use of are: the indices of refraction at two different wave-lengths, the density of the substance, the dielectric constant, the molecular diameter and certain universal constants. The value obtained is much smaller than that calculated from the hypothetical molecular structure. This is due to the shifting of charges under the forces of attraction and repulsion within the molecule, and depends on the ease of displacement of the electrons. The moments of saturated hydrocarbons are very small, of hydrocarbons with double bonds small, but of sufficient magnitude to indicate a possible tendency toward an electronic shift in the neighbourhood of the bond. Alcohols, ethers, aldehydes and ketones have moments of the same order of magnitude as that of water, as required by the hypotheses as to their structure; ammonia and the amines have smaller moments, partly owing to their molecular structure, and partly because the electrons round the nitrogen nucleus are more easily displaced than those about the oxygen nucleus. The paper also deals with the increase in the moment with increase in the length of the carbon chain, and shows that, in the hydrogen and organic halides, the moments of the iodine compounds are lower than those of the bromine compounds, which in turn are lower than those of the chlorine compounds. The mutual repulsion of two halogen atoms decreases the moment, the shift of the pairs of binding electrons adding to the decrease. H. N. A.

288. *On the Determination of Molecular Fields. I. From the Variation of the Viscosity of a Gas with Temperature.* **J. E. Jones.** (Roy. Soc., Proc. 106. pp. 441–462, Oct. 1, 1924.)—An indirect method of investigating the forces called into play when two gaseous molecules collide is to assume a definite law of force, and deduce the relation of the viscosity to the temperature by means of the kinetic theory. Maxwell assumed that the molecules repel according to the inverse fifth power law; more recently formulæ have been obtained (1) for repulsion according to the inverse *n*th power law, (2) collision like rigid elastic spheres, (3) rigid elastic spheres with a weak attractive field of force surrounding them. The last, Sutherland's model, has given the best agreement between theory and experiment, but there are considerable divergences at low temperatures. The author uses a new molecular model; the molecules repel according to an inverse *n*th power law, and attract according to the inverse third power; the only justification for this particular attractive field is that it renders the integrals tractable. A complicated mathematical treatment of the problem shows that the viscosity varies as $T^{3/2} \div (T^{(n-3)/(n-1)} + S)$ where S is a quantity independent of the temperature T, and *n* is the index of the repulsive field. This new relation includes the previous ones as special cases, and may be regarded as more general than them. The viscosity of argon can be represented by means of the above formula through the whole range of 370° observed, with only 0·6 % divergence, while Sutherland's formula gives a divergence of 8 % at the lowest temperature. It is not possible, however, to determine the values of *n* and S uniquely; with argon equally good agreement is obtained for $n = 20$ with $S = 62\cdot45$ and $n = 14\cdot3$ and $S = 38\cdot62$; thus viscosity alone is not sufficient to determine the nature of the molecular fields absolutely; any one of a specified range of molecular models is a possible one. The nature of the attractive field is left undetermined. The following table gives the repulsive forces and "diameters" for argon calculated for different values of *n*.

n.	λ_n.	$\sigma 0 \cdot 10^{8}$ cm.
14·33	$3\cdot573 \times 10^{-113}$	4·698
21	$2\cdot818 \times 10^{-163}$	3·987
25	$2\cdot610 \times 10^{-193}$	3·795
∞	∞	2·84

$\lambda_n r^{-n}$ is the value of the repulsive field. H. N. A.

289. *On the Determination of Molecular Fields. II. From the Equation of State of a Gas.* **J. E. Jones.** (Roy. Soc., Proc. 106. pp. 463–477, Oct. 1, 1924.)—In the case of argon the author has shown that it is possible, by means of more than one molecular model, to explain the temperature variation of viscosity [see preceding Abstract]; he now obtains a model of the same type to explain the experimental data concerning the equation of state of the gas, and finds its relation to the viscosity models. Kamerlingh Onnes deduces from the observations the empirical equation $pv = A + B/v + C/v^2 + D/v^4 + E/v^6 + F/v^8$, where A — — — F, the virial coefficients, are determined as functions of the temperature to fit the observations. It is shown that B can be evaluated, in the case of the general model which explains the viscosity results, though the force constant of repulsion is found to be greater in all cases than the viscosity value.

n.	Equation of State.			Viscosity.	
	Repulsive Force Constant.	Attractive Force Constant ($m = 5$).	Diameter.	Repulsive Force Constant.	Diameter (in cm.).
14·5	$6{\cdot}020 \times 10^{-112}$	$1{\cdot}500 \times 10^{-43}$	5·806	$3{\cdot}573 \times 10^{-113}$	$4{\cdot}698 \times 10^{-8}$
21	$2{\cdot}018 \times 10^{-161}$	$1{\cdot}296 \times 10^{-43}$	4·935	$2{\cdot}813 \times 10^{-163}$	3·987
25	$5{\cdot}068 \times 10^{-191}$	$1{\cdot}283 \times 10^{-43}$	4·726	$2{\cdot}610 \times 10^{-193}$	3·795
∞	0	$1{\cdot}009 \times 10^{-43}$	3·578	0?	2·84

In an appendix the recent results of Holborn and Otto are discussed, which give the isotherms of a number of gases, including argon, at temperatures between 0° and 400° C.; these give for the different models the values in the following table, those of λ_n and λ_5 being in all cases less than those deduced from Kamerlingh Onnes' results; while the diameter of the rigid sphere is about 10 % greater than that given by viscosity, the former result is about 25 % greater.

n.	Repulsive Force Constant (λ_n).	Attractive Force Constant (λ_5).	Diameter (in cm.).
14·5	$1{\cdot}636 \times 10^{-112}$	$1{\cdot}1324 \times 10^{-43}$	$5{\cdot}107 \times 10^{-8}$
21	$2{\cdot}338 \times 10^{-162}$	0·9612	4·342
25	$2{\cdot}955 \times 10^{-192}$	0·9256	4·128
∞	0	0·704	3·131

The experimental work of Holborn and Otto is being used to investigate the fields of helium and neon, using the same methods. The discrepancy between the results obtained by the viscosity and equation of state methods may be due to the fact that the molecular fields determined are not strictly comparable; one method gives the forces between molecules during an encounter, the other gives a statistical average of the forces on a molecule due to all those which surround it. H. N. A.

290. *Electron Displacement in Carbon Compounds. I. Electron Displacement versus Alternate Polarity in Aliphatic Compounds.* **H. J. Lucas and A. Y. Jameson.** (Am. Chem. Soc., J. 46. pp. 2475–2482, Nov., 1924.)—Criticises the evidence brought forward by Cuy in support of the alternate polarity theory of open chain compounds, and shows that the effects of the addition of hydrogen halides to propylene, to acrylic acid and to dimethyl allene can be explained just as satisfactorily from the standpoint of electron displacement as from that of alternate polarised carbon atoms. The addition of hydrogen bromide to diethyl allene and the rearrangement of 1-bromobutane to 2-bromobutane are better explained on the basis of electron displacement; the author has found experimentally that 1-bromobutane, when heated at 248°, rearranges to 2-bromobutane; the reaction is monomolecular, and apparently non-reversible, or reversible to a slight extent only. H. N. A.

291. *Physical System of the Elements.* **C. G. Bedreag.** (Comptes Rendus, 179. pp. 766–768, Oct. 20, 1924.)—The limitations of previous attempts at a systematic arrangement of the elements, from that of Mendeleeff onwards, are briefly referred to, and a table is presented which contains the elements disposed in six horizontal ranks, corresponding to the six periods required by Bohr's theory, the number of columns being carried to eighteen, corresponding to the eighteen families of elements clearly characterised by all their fundamental properties. It is shown that this table can be represented graphically with atomic numbers as abscissæ and the successive families or columns as ordinates. The first four periods of the graph thus obtained are susceptible of a simple analytical interpretation by development in a Fourier series. A. B. C. L.

292. *The Radical Theory in Modern Chemistry.* **C. A. Kraus.** (Am. Chem. Soc., J. 46. pp. 2196–2204, Oct., 1924.)—In a compound containing a large number of atoms a corresponding number of valency bonds exist. In the course of reaction some of these bonds break down. The different valency bonds in a compound have varying degrees of stability and those atoms which are joined by the more stable bonds remain combined with one another throughout a series of reactions. These relatively stable groups are termed radicals. The paper suggests that stable groups of elements may be arranged in a twofold series of electro-affinities similar to that of the elements. It is pointed out that the properties of these groups in the free state correspond to those of elements of the same electro-affinity. Groups intermediate in the series exhibit marked amphoteric properties; that is, they appear in an electronegative or electropositive state depending on conditions. The properties of the univalent amphoteric groups correspond closely to those of hydrogen, which is the only univalent amphoteric element known. The properties of the trimethylstannyl group and its compounds are discussed in detail and compared with those of hydrogen. S. G. B.

293. *Suggestions for a Magnetic Theory of Valency.* **A. P. Laurie.** (Faraday Soc., Trans. 20. pp. 1–10; Disc., 11–12, Aug., 1924.)—This theory is based on the assumptions that the electrons are arranged round the nucleus in a series of rings or shells as shown in the Langmuir atom, and that the electrons themselves are moving in tiny orbits assumed to be of much smaller diameter than the atom. The atom is supposed to be drawn in one plane with the orbits of the electrons at right angles to the plane and inserted radially round the nucleus, so that they may be represented in plan as a short straight line with a north and south magnetic face on each side respectively. According to this hypothesis, the combination between two non-metallic elements involves the sharing of magnetons as in the Langmuir hypothesis, but in the case of a non-metallic combining with a metallic element, the transference of one or more magnetons is followed by the combination of the non-metallic with the inner shell of the metallic element. This view of chemical combination is in general agreement with what is known of the arrangement of atoms and ions inside a crystal, and seems to reconcile the fact that ionisation of sodium and chlorine has already taken place in the sodium chloride crystal with the known facts of solution of the salt in water. If the sodium and chlorine ions are imagined as passing into solution, they would be magnetically attracted and tend to form molecular groups, except in so far as they become separated by the hydration of the respective ions, and for any given strength of solution there would be an equilibrium set up between the number of ions combined with each other and the number of separated hydrated ions, this agreeing with the old hypothesis of ionisation on dilution.

Application of these views to the formation of polymerides of the water molecule and of hydrates indicates that for "perfect" hydrates, three water molecules are required for ions with either three or six external magnetons, four water molecules for those with four or eight such magnetons, and so on. There are doubtless intermediate hydrates, but only these perfect hydrates fulfil the conditions necessary in order that dilute solutions may obey the gas laws. Assuming such a method of combination between two Langmuir atoms, it is shown that the passage from a Langmuir molecule to a molecule of the Bohr type is easy. T. H. P.

294. *Valence of the Rare Earths on Bohr's Theory.* **F. Zambonini.** (Accad. Lincei, Atti, 33. ii. pp. 16–20, July, 1924.)—It is suggested that the group of rare earth elements behave either as di- or tri-valent metals. On the lines of the Bohr theory it is pointed out that while the outer electrons are two in number, there occurs within, a single electron over and above the stable number, four. It is supposed that this electron can behave as a valency electron in certain cases, though the trivalence of such elements would not be as prominent as in the typical trivalent metals such as aluminium. A characteristic of trivalent metals is the formation of alums, and it is probable that double salts of the alum type may be formed by the rare earth metals. A. Wh.

295. *The Application of Weber's Formula for the Calculation of the Deviation of Luminous Rays.* **Fournier.** (Soc. Franç. Elect., Bull. 4. pp. 605–610, July, 1924.)—The paper opens with a statement of the formula propounded by Weber for the force F between two masses M and m at two points along the straight line forming these points and states it as follows:

$$F = -\frac{Mm}{r^2}\left(1 + \frac{2rd^2r - dr^2}{c^2 \cdot dt^2}\right)$$

where c is the velocity of propagation of light. Using Weber's formula for the calculation of the movements of planets, Tisseyrand found that for the secular displacement of the perihelion of Mercury the value so obtained was only one-third of the observed value. The author recalls that Newton had foreseen the existence of an attraction between a body and light. Theoretically, it is then established that Weber's formula gives a value of 1″·74 for the deviation of luminous rays, which is in entire agreement with the mean of the values observed by Campbell and Turner during the eclipse of 1922. At the same time it is noted that these values were considerably divergent. The deviation (ϕ) is deduced from the final formula obtained—

$$\phi = \frac{4M}{c^2R}.$$

S. G. B.

296. *A Theory of Gravitation and Radiation.* **W. Gore.** (Roy. Astron. Soc. Canada, J. 18. pp. 345–366, Oct., 1924.)—A quasi-elastic ether which is displaced by material particles is postulated. All motion in the ether is stream-line motion and there are no losses due to viscosity. The presence of a material body distorts the ether and such distortions travel from their origin with the velocity of light. In regions undisturbed by matter there exist systems of positive and negative columnar vortices extending to infinity in both directions. Distortion of these vortices is resisted by the gyrostatic forces called into play. Sixteen assumptions are made and several examples of the applicability of the theory are given. The Fitzgerald contraction is explained as the deformation of matter, considered as elastic, under the fluid forces produced by motion through the ether. Also the stationary orbits of the Bohr atom are those in which the electron makes a minimum number of encounters with vortices. Certain calculations are made of the magnitude of the physical quantities involved. A. Wh.

METEOROLOGY AND GEO-PHYSICS.

297. *A. Schuster's Probability Theory.* **V. Conrad.** (Meteorolog. Zeits. 41. pp. 299–306, Oct., 1924.)—A summary is given of the development of Schuster's investigation of hidden periodicities with the application to a supposed 26-day period of meteorological phenomena. Four general cases are dealt with. (1) Separation of isolated independent events. (2) Isolated events occurring in groups (meteors, sun spots, etc.). (3) Totals independent of one another (harvest crops, yearly totals of precipitation, etc.). (4) Totals of a succession of events (daily means of pressure and temperature, etc.). The theory developed for these cases is applied to meteorological phenomena and particularly to yearly totals of precipitation at Vienna. No exact periodicity can be found with a 12-year or other period for over 75 years of observations. The material is insufficient to confirm the existence of the Brückner period for precipitation at Vienna, and observations extending over 150–160 years are required to prove its existence. R. S. R.

298. *Wind Observations over the N. and S. Atlantic up to 20 Kms.* **P. Perlewitz.** (Meteorolog. Zeits. 41. pp. 317–318, Oct., 1924.)—Preliminary report on the results obtained during a voyage in the Atlantic Ocean, March–June, 1924. It was found that the upper surface of the zone for W. winds in moderate latitudes rises towards the equator, the rise continuing over about 10° of latitude. The W. wind was also found above the N.E. and S.E. trade winds and the equatorial calms at heights between 5 and 20 kms. over a belt of about 10° of latitude, the actual position of the layer moving N. or S. with the weather and time of year. The distribution of N. and S. components of the winds from 55° N. to 35° S. latitude is given for different latitudes and heights. Gales occur in all parts and from all directions. Percentages are given for March and June of journeys by air which could be made between Buenos Aires and the Kiel Canal with following winds. R. S. R.

299. *Researches into European Upper Air Data, with Special Reference to the Life History of Cyclones.* **C. K. M. Douglas.** (Roy. Meteorolog. Soc., J. 50. pp. 339–361; Disc., 361–363, Oct., 1924.)—Details of the early stages in the life of individual cyclones are considered with reference to the source of the air in the warm sector; the temperature above the warm sector is higher than that over the other parts. A large part of the kinetic energy of a cyclone is available from the convective overturning of adjacent masses of air at different temperatures. The most favourable condition for the formation of a cyclone appears to be a tongue of warm air extending into a colder mass and so providing an initial centre for a vortex. A. W. L.

300. *Atmospheric Pleochroism.* **J. J. Tichanowsky.** (Phys. Zeits. 25. pp. 390–391, Aug. 1, 1924.)—Some further account of atmospheric polarisation is given. Under certain conditions the pleochroism can become extreme—the two components blue and violet-blue. Generally, at midday they are grey and a turbid blue. [Abstracts 654 (1923) and 2212 (1924).] W. A. R.

301. *A New Method of Determining the Dew Point.* **M. Holtzmann.** (Phys. Zeits. 25. pp. 443–445, Sept. 15, 1924.)—A cooling liquid is passed upward through a vertical tube of polished copper, at the top of which is a heating coil. A fine horizontal line is marked on the tube, and to two points on this line two fine wires are soldered, forming a thermo-electric junction. By manipulating the flow of the liquid, the temperature of which is a couple of degrees below the dew point, and the current in the heating coil, it is possible to adjust the variation of temperature along the tube so that dew is formed all over the portion below the horizontal mark, while the upper part remains bright. The temperature is read at this instant on the galvanometer. Values differing from one another by about 0·02–0·03° can be obtained by this method. In a second form of instrument, which can be used in very small spaces, a so-called probe hygrometer, the lower end of a thin silver rod is cooled in a vessel containing ether, through which air is bubbled; a heating coil is wound round the upper end, a flat is cut and polished on the side of the rod, a horizontal mark is made on it, and the two fine wires forming the thermo-element are soldered to the ends of the mark. Only the small portion of the rod with the flat on it need be placed in the bulb in which the humidity is to be determined. H. N. A.

302. *If the Earth went Dry.* **N. Shaw.** (Nature, 114. pp. 684–689, Nov. 8, 1924. Paper read before the British Assoc., Toronto, 1924.)—The author discusses the modifications which would be occasioned to the meteorology of the globe by the removal of the water-vapour from the atmosphere. In the dry atmosphere upward convection would be limited to that of dry air, consequently the stratosphere would be lower; the downward convection along a surface which is losing heat by radiation would be undiminished and katabatic winds in polar regions would be as strong as at present. The discontinuities of temperature and wind velocity typical of the polar front would still occur. Diagrams are given to show the distribution of temperature and potential temperature over the dry earth at the solstice and equinox. It is concluded that the general and local circulations would be of the same type as at present but would differ in intensity. A. W. L.

303. *Atmospheric Electricity and the Theory of Cyclones.* **H. Markgraf.** (Meteorolog. Zeits. 41. pp. 314–316, Oct., 1924.)—Continuing the analysis of perturbations of atmospheric electricity [see Abstract 2214 (1924)] the present paper deals with the behaviour of the atmospheric-electrical elements coincident with wind veerings based on the Potsdam records of potential gradients for 1912. In observing veerings of at least 90° it was found that south winds are accompanied by a mean maximum conductivity and a minimum potential gradient, and that the potential gradient is greater in the polar than in the equatorial air currents. As the turning points of the wind in cyclones show these maxima and minima the two phenomena would appear to be connected. E. F.

304. *Sunspots and the Frequency of Tropical Cyclones.* **S. S. Visher.** (Am. J. Sci. 8. pp. 312–316, Oct., 1924.)—No evidence is found in favour of a relationship between the annual variation of sunspots and annual frequency of tropical cyclones in the Pacific; if monthly values are taken the variations are in closer agreement, but the relationship is weak and appears to vary from place to place. A. W. L.

305. *Radiogoniometric Observations at Shanghai.* **E. Gherzi.** (Onde Élec. 3. pp. 542–544, Nov., 1924.)—In a preceding paper the author has shown [see Abstract 45 (1925)] that a systematic study of the direction of atmospheric disturbances leads to the belief that typhoons ought not to be considered as centres of disturbances. In the present paper it is endeavoured to verify the findings of Mesny concerning (1) the decrease in deviations with the increase of the distance of the emitter, (2) the stabilising effect attributed to the great extent of sea traversed by the waves. A. E. G.

306. *Mistakes in Methods of Palæoclimatology.* **F. v. Kerner.** (Meteorolog. Zeits. 41. pp. 293–298, Oct., 1924.)—The paper deals with the general lines of approach usually employed when investigating climate in different parts of the earth in earlier geological times. The several sources of error which occur in many investigations are considered in detail and the failure to take into account sufficient factors is emphasised. The distribution of fossil plants and other fossil beds is explained as a result of all factors composing the climate and not merely an index of prehistoric temperature. The evidence of glacial action on rocks, the heaping up of boulders, the formation of saline deposits, and of the occurrence of æolian sand deposits are considered in their relation to coexisting climatic conditions. R. S. R.

307. *Lake Level in Relation to Rainfall and Sunspots.* **F. Dixey.** (Nature, 114. pp. 659–661, Nov. 1, 1924.)—A study of the variations in the level of Lake Nyassa shows the existence of a relationship between the lake level and sunspot numbers similar to that already found for

Lakes Victoria and Albert; this relationship is rendered somewhat indefinite by irregular variations caused by changes in the Upper Shire River and also by the imperfection of the records of lake level. Considerable variations in level have occurred during historic times, but there is no evidence to show that any progressive rise or fall has taken place. A. W. L.

308. *Perturbations of Harmonic Tidal Constants.* **A. T. Doodson.** (Roy. Soc., Proc. 106. pp. 513–526, Nov. 1, 1924.)—An explanation is given first of the usual method of development for the analysis of tidal observations, and it is shown that the relations obtained are on the whole justified in practice, but in some cases the "harmonic constants" obtained from yearly analyses of observations show marked variations. The values for Bombay (Apollo Bandan) and St. John, N.B., are investigated particularly. Three definite perturbations are indicated, the first having a period of nineteen years, corresponding to the period of revolution of the moon's nodes; the second with a period of about four years; and the third a secular change of unknown origin. After removing all known perturbations certain secular changes remain, and there is evidence that the tides are decreasing in range at some places and increasing in range at others. The changes of sea-level are not of sufficient magnitude to account for the secular changes, but they may be due to possible changes in the sand and mud banks near to the ports examined. The influences of tidal friction and of resonance are also investigated. R. S. R.

309. *Deductions from Recent Researches on the Periodic Variations of Glaciers.* **U. Monterin.** (Accad. Sci, Torino, Atti, 59. 14. pp. 309–322, 1923–1924.)—An examination of the work of Forel, Brückner, de Marchi, Paroni, and Somigliana leads the author to the view that periodic variations are due rather to fluctuations in temperature in consequence of variations of radiation depending on atmospheric conditions, nebulosity, etc., than to greater or less precipitation. The confirmation of this hypothesis would be of extreme importance, as it would warrant the conclusion that the great glacial expansions of the Neozoic, possibly also of the Precambrian, Carbon and Permian, were due rather to a notable diminution of summer denudation than to greater snowfalls of those periods. E. F.

ASTRO-PHYSICS.

310. *Cosmic Dust in the Solar Corona.* **W. Anderson.** (Zeits. f. Physik, 28. 5. pp. 299–324, 1924.)—Within a solar radius distance from the photosphere no solid particles of carbon could exist; they would evaporate, more rapidly than fresh ones could take their place. Similar results follow for other elements. Reasons given for also excluding larger particles. The Arrhenius theory has therefore to be abandoned. A. D.

311. *Movement of a Fluid Celestial Body round its Centre of Gravity.* **P. Appell.** (Comptes Rendus, 179. pp. 795–796, Oct. 27, 1924.)—The sun and certain planets do not turn all of a piece round an axis passing through their centre of gravity. The author shows that they could not possibly do so. A. D.

312. *Perspective Shortening in Spectroheliograms and Transparency of the Photosphere.* **W. H. Julius.** (K. Akad. Amsterdam, Proc. 27. 5–6. pp. 451–458, 1924.)—If the flocculi were due to a bright and dark structure, confined to a spherical shell of less than a thousand kilometers thick, they would appear foreshortened near the limb. The author's observations show that there is very little foreshortening in H_α spectroheliograms, and an examination of the results of other observers confirms this, though the fact does not appear to have been mentioned previously. It is supposed that the layer which produces the flocculi is very deep, at least 13,000 km., and probably much more; it consists of a rare transparent gas, and the distribution of light in the flocculi is only due to a very small extent to emission of the gas, but mainly to anomalous refraction of waves belonging to the continuous spectrum from a lower level, as they pass through irregular gradients of optical density in the gas of the above deep photospheric layer. An experiment has been devised to illustrate the theory: A lamp with a spherical bulb of milk-white glass is surrounded by a concentric transparent globe, the space between the globes being filled with irregular glass grains with water in the interstices; the whole is submerged in a glass tank containing water. A photograph shows a striking similarity to the H_α flocculi, with the same want of foreshortening at the edges of the globe. Using the calcium lines H or K perspective shortening is more apparent than with H_α. An explanation is given for this difference, based on molecular scattering, the distance into the sun that one can see with violet light being less than with red light. H. N. A.

313. *Lunar Phenomena and Gravity.* **F. Sacco.** (Accad. Sci. Torino, Atti, 59. 2, 3 and 4. pp. 53–57, 1923–1924.)—The high mountains and deep valleys on the moon's surface lead one to suppose that they were originated by peculiar volcanic conditions. In the present article the author furnishes an explanation of this phenomenon. The intensity of gravity on the moon due to its mass (about 1/6th that on the earth) is not a sufficient reason, and the absence of an atmosphere can be only of small importance. The combined attraction of the sun and the earth on the moon is fifteen times greater than that of the sun and the moon on the earth, so that the resultant force of gravity on the moon is about 1/90th that upon the earth. But taking into account the fact that when the moon was subjected to these profound convulsions it was much nearer the earth than it is now, the resultant force of gravity was then much smaller (1/720, on the supposition that the distance was only half the actual). This would fully account for the important movements on the moon's surface. E. B.

314. *Ellipticity of Saturn's Ring.* **G. R. Goldsbrough.** (Roy. Soc., Proc. 106. pp. 526–552, Nov. 1, 1924.)—It is shown that an elliptic ring is a possible configuration of the particles composing Saturn's ring. Such a ring will be " ordinarily " stable for conditions similar to those involved in Maxwell's theory of a circular arrangement. Superimposed on the motion of the particles in the ellipse are small periodic oscillations of the same period, while the ellipse rotates slowly in its own plane. This state of affairs might be detected by the periodic analysis of measurements of Saturn's ring. A. Wh.

LIGHT.

315. *Colours shown by Nobili's Rings.* **B. N. Chuckerbutti.** (Indian Assoc. for Cultivation of Science, Proc. 9. 1. pp. 83–91, 1924.)—Several electrolytic methods are dealt with by which Nobili's rings may be produced. To obtain the best results the current must be sufficiently high, the metal surface highly polished, and the vertical electrode as near as possible to the plate without touching it. When observed through a microscope the deposit is found to be granular in structure, with particles whose sizes range from 275 $\mu\mu$ to 500 $\mu\mu$, the same order of size as for particles formed on heated metal surfaces [see Abstract 664 (1923)]. The ring systems were studied by observations on the colour and polarisation of light reflected and scattered by them for high angles of incidence, and photographs show the complementary nature of the reflected and scattered light. R. S. R.

316. *Formula for Colorimetric Purity.* **I. G. Priest.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 503–520, Nov., 1924.)—A colour may be expressed on the trichromatic system by means of three coordinates defining the proportions in which three primary colours (suitably chosen) must be mixed in order to match the given colour. It may also be expressed on the monochromatic system by the wave-length of the spectral light which, mixed with white, will match the given colour. The fraction of the mixture, which consists of the spectral colour, is known as the " purity " of the given colour. The author deduces, by means of the Maxwell triangle, formulæ for determining this quantity from the coordinates of the colour on a given trichromatic system. J. W. T. W.

317. *Temper Colours.* **C. W. Mason.** (J. Phys. Chem. 28. pp. 1233–1244, Dec., 1924.)—The author reviews the several theories which have been advanced to account for the temper colours of metals, and inclines quite definitely to the view originally stated by Newton that the colours are caused by interference of light reflected from the two surfaces of a more or less transparent film of a compound of the metal formed on its surface, in a manner corresponding precisely to Newton's rings. Any reticulated or granular structure of the film adds to the vividness of the colour, while a moderate degree of opacity enhances the colour. The colour of the material of the film itself obscures the interference colours in the case of thicker films. The theory is supported by the similarity of the colour sequence, as films are formed on different metals under different conditions and when the films are gradually removed by acids, while further support is given by the change of colour with changing angles of incidence of the light. Other views advanced to account for these colours, such as selective reflection, diffraction and resonance are examined in detail and rejected as inadequate. Properties similar to those of " frilled films " are probably due to the fine structure of the film, but these are of minor importance in the appearances observed under ordinary conditions. [See Abstract 1559 (1923).] R. S. R.

318. *Optical Absorption of Dissolved Salts.* **H. v. Halban** and **L. Ebert.** (Zeits. phys. Chem. 112. pp. 321–358, Sept. 30, 1924.)—The photo-electrical arrangement previously described [*ibid.* 96. pp. 214–232, 1920, and Abstract 895 (1923)] has been modified so as to give results of a high degree of accuracy in the study of absorption. The results obtained in this way for the molecular extinction coefficients of solutions of a number of absorbing salts show that with dilute solutions Beer's law is obeyed. The effects produced on these extinction coefficients by the presence in the solutions of non-absorbing salts are considerable and vary in sign and in magnitude with the wave-length. Spectrophotometric measurements on sodium picrate solutions show that the effect of an added salt is much greater in methyl alcohol than in water.

The theoretical and practical signification of these results is discussed. T. H. P.

319. *The Absorption Curves of Some Dye Solutions.* **T. Ōtashiro.** (Phys. Math. Soc. Japan, Proc. 6. pp. 30–32, March, 1924.)—Vavilov has determined the coefficient of absorption of aqueous solutions of fluorescein, eosine and rhodomine [Abstract 1301 (1922)]. Using his experimental data, the author shows that the connection between this coefficient $\varkappa$ and the wave-length λ can be expressed by the relation $\varkappa c = \lambda^{-1}\Sigma a e^{-b(\lambda-\lambda_0)^2}$, where c is the concentration and a, b, λ_0 are parameters independent of the wave-length. Tables are given with the values of the parameters and of the observed coefficients compared with the calculated ones. The suggested explanation, from the standpoint of the quantum theory, is that an absorbing medium consists of a number of different systems of absorbers, and that the number of quanta in each system is distributed along the wave-lengths, following the principle of probability. H. N. A.

320. *The Influence of Atomic Arrangement on Refractive Index.* **W. L. Bragg.** (Roy. Soc., Proc. 106. pp. 346–368, Oct. 1, 1924.)—The additive law, based on the atomic refractivities, for molecular refractivity is, in general, only obeyed approximately, and in many cases breaks down entirely. The relation between the average electric force inside a medium $\overline{E}$, the total polarisation P and the dielectric constant is worked out in terms of the polarisation of the atoms, the field about each of which is equivalent to that of an electrical doublet with moment se proportional to the exciting field. With random distribution of the surrounding atoms the polarising field is $(\overline{E} + \frac{1}{3}P)$, and may create a doublet with moment $(\overline{E} + \frac{1}{3}P)e^2\lambda$ where λ is a constant characteristic of the atom. Different chemical bindings will alter the value of λ. In crystalline bodies the term $\frac{1}{3}P$, deduced for random distribution, no longer holds, and must in general be replaced by a more complex expression. The effect of the method of chemical binding has been discussed by the author for calcite and arragonite in a recent paper, with relation to their crystalline structure, an explanation being given of birefringence in these substances. A comparison of six carbonates of the calcite series shows that, while the birefringence has a wide range, the molecular birefringence only varies from 2·53 to 2·94. The influence of the oxygen atoms in the same CO_3 group, which is the most important factor, is the same for each of these substances, and only the smaller influence of atoms in other groups varies from crystal to crystal. Aluminium oxide is treated in the same way, the process of calculation leading to more accurate results than in the case of calcite. The refractivities of the alkaline halides are discussed;

the calculated values tend to be larger than the observed. An attempt has been made to attack the reverse problem, using the refractivity data to obtain information about crystal or molecular structure. A comparison of refractivity in carbonates and nitrates indicates that the NO_3 group is contracted, as compared with the CO_3 group, and a value for the distance between the N and O atomic centres is obtained. The possibility of extending similar reasoning to gaseous molecules is discussed. H. N. A.

321. *Anisotropic Transparence and Diffusion in Oriented Liquid Crystals.* **A. Perrier.** (Arch. des Sciences, 6. pp. 233–243, July–Aug., 1924. Paper read before the Soc. Suisse de Physique, Lausanne, May, 1924.)—The author discusses, with the help of the classic laws of double refraction, the various effects produced on light by the surfaces separating doubly refractive media of specific properties. As a result, it is shown that the apparent differences conferred on (incompletely) oriented liquo-crystalline masses by light parallel and perpendicular to the direction of orientation (that of the electric or magnetic field) are not attributable to any parasitic phenomenon but are natural consequences of the known laws. Such partially oriented masses should be more transparent and less diffusive for rays parallel to the axis of orientation than for normal rays, and, moreover, the residual transversal light (not diffused) should be polarised in a direction parallel to the axis of orientation. These considerations give rise to the notion of media with anisotropic diffusion, which is distinct from pleochroism. T. H. P.

322. *The Absorption of Radiation by Multiple Periodic Orbits, and its Relation to the Correspondence Principle and the Rayleigh-Jeans Law. Parts I and II.* **J. H. van Vleck.** (Phys. Rev. 24. pp. 330–365, Oct., 1924.) —The present publication represents a much more complete account with supplementary matter of a recent paper [see Abstract 2849 (1924)]. Part I considers some extensions of the correspondence principle from the standpoint of the quantum theory, the previous paper [*loc. cit.*] being mainly based on classical mechanics. In the absence of external radiation fields, the distortion in the shape of the orbit is essentially the same in both the classical and quantum theories, provided in the former only one particular term τ_1, τ_2, τ_3 be retained in the multiple. Fourier expansion of the force $2e^2/3vc^3$ on the electron due to its own radiation, this being the combination overtone asymptotically connected to the particular quantum transition under consideration. Then the changes $\Delta\tau_1$, $\Delta\tau_2$, $\Delta\tau_3$ in the momenta τ_k which fix the orbits, and which in the stationary states satisfy the relations $\tau_k = n_k h$, are in the ratios of the integers τ_1, τ_2, τ_3 in both the classical and quantum theories, making the character of the distortion the same in both even though the speed of the alterations may differ. One particular term in the classical radiation force is thus competent to bring an orbit from one stationary state to another. The correspondence principle is then extended so as to include absorption as well as the spontaneous emission ordinarily considered. Commencing always with a given orbit it is possible to pair together the upward and downward transitions in such a way that in each pair the upward and downward optical frequencies (determined by the $h\nu$ relation) are nearly equal for large quantum numbers (usually long wave-lengths). It is proved that for large quantum numbers the classical theory value for the ratio of absorption to emission approaches asymptotically the quantum theory expression for the ratio of the differential absorption to the spontaneous emission. Consequently a correspondence principle which makes the numerical values of the emission in the two theories agree asymptotically, of necessity achieves a similar connection for the absorption. The correspondence principle basis for a dispersion formula proposed by Kramers, which assumes the dispersion to be due not to the actual orbits but to Slater's "virtual" or "ghost" oscillators having the spectroscopic rather than orbital frequencies, is then presented. Kramers' formula had both positive and negative terms, and the differential dispersion is defined in a manner analogous to the differential absorption. It is shown that the quantum differential dispersion approaches asymptotically the dispersion which on the classical theory would come from the actual multiply periodic orbit found in the stationary states. This asymptotic connection for the general non-degenerate multiply periodic orbit must be regarded as an important argument for Kramers' formula.

Part II, which calculates absorption by a multiply periodic orbit in a field of radiation and the corresponding perturbations in the orbits, is largely dynamical, and presents the mathematical analysis on which Part I is largely based. It gives in addition the polarisation produced by incident waves, causing dispersion, and the distortion of the orbit by its own radiation. Most of these calculations have previously been given only for special cases. H. H. Ho.

323. *The Selective Absorption of Coloured Glasses and a Radiometric Method for the Determination of Reflective Power.* **Marya Kahanowicz** and **Ada Estrafalaces.** (Comptes Rendus, 179. pp. 890–893, Nov. 3, 1924.)—The paper contains the deduction of simple expressions for the selective absorption and reflective powers of coloured glasses by data obtained from certain monochromatic systems. In the experiments described, the source was nickel oxide heated to temperatures between 500°–1120° C. with Féry's pyrometric lens as receptor. Brief experimental details are included for red glass, type F 4512, and blue glasses, F 3873 and F 3654, made by Chott of Jena. The energy curves lead to the expression, $E = AE_0 e^{\beta T}$, where E_0 and E indicate the energies corresponding to the total and filtered radiation respectively, T is the absolute temperature of the source, and β a constant. The conclusions are drawn that the coefficient of transparence $D = \delta\Delta\lambda/d$, and the reflective power $R = Ad/\delta\Delta\lambda$, where d is the thickness of the glass and λ the wave-length of the band. The law of selective absorption is then given by $E = R\delta\Delta\lambda E_0 S/d$, where the factor $R\delta\Delta\lambda/d$ includes the monochromatising function of the factor, while S is determined by the emission of the source with respect to the spectral zone λ. For a grey source at T, $S = e^{cT/\Delta\lambda}$, where $c = \beta\Delta\lambda$. This law of selective absorption is thus essentially different from that of Beer, since the extinction is determined not merely by an exponential function of the thickness, but by the monochromatising function $R\delta\Delta\lambda/d$. The new law furnishes a radiometric method for the determination of the reflective power.

H. H. Ho.

324. *Optical Records and Relativity.* **C. L. Morgan.** (Nature, 114. pp. 577–579, Oct. 18, 1924.)—After discussing at some length the value of optical images on the retina of the human eye, the author enunciates two hypotheses, namely, (1) that the spatial-temporal relations in the retinal record reveal those that obtain in the source of that record; and (2) that the nature of the conscious reference in perception is such that the object of vision is fashioned on the spatio-temporal configuration *of the record*—that is, that changes in the record are referred to that which is the source of that record. He goes on to show that the photographic record implies a retinal record, so that it is merely an instance of vision at second-hand. A good deal of this article is based upon the psychological and logical aspects of visionary and optical records, dealt with in generalities; no qualitative data are given. A. W. J.

325. *Transmission of Glass Plates or Prisms.* **J. Barot.** (Rev. d'Optique, 3. pp. 459–463, Oct., 1924.)—Describes the method of measuring the transmission of a glass plate or of a right-angled prism by means of the Yvon spectrophotometer. (Rev. d'Optique, 1. pp. 499–507, Dec. 1922.) J. W. T. W.

326. *Modification of the Method of Zones (Ritchey) for the Determination of the Aberrations of Optical Systems: Its Extension to Aberrations without the Axis.* **J. Cojan.** (Comptes Rendus, 179. pp. 893–895, Nov. 3, 1924.)—The determination of the focus of a zone is made by photometric measurement, and difficulties arise when the compared illuminations are not contiguous. In the cases of very open systems, such as certain photographic objectives, the eye may not perceive both fields simultaneously and the equalisation is made by memory. This inconvenience disappears if the visual be replaced by a photographic measure, and an experimental device is now described for enabling such practice. The compared intensities are measured by a microphotometer, and the focal position may be deduced therefrom with great accuracy by interpolation. The advantages claimed for the method include the superior contrast to that afforded by the eye in the ratio of 8 : 1, giving the focal position to about 0·01 mm., and also applicability to the extreme regions of the visible spectrum. Two examples are included. An extension to the case of oblique aberration is described with an example, although the accuracy is rather less than in the former applications discussed. H. H. Ho.

327. *Optometer for Visual and Chromatic Acuity.* **E. Guérin.** (Rev. d'Optique, 3. pp. 418–429, Sept., 1924.)—Describes an instrument used by the French Ministry of Marine and several railway companies for examination of visual acuity and of colour discrimination. The optotypes used are the letters and signs of the Monoyer (decimal) scale, and Landolt's rings. Only one letter or sign is visible at a time. The signs are printed on a translucent ribbon which can be moved across a window in a box containing a source of light. The brightness of the background is variable, by means of absorbing screens, for the purpose of studying nocturnal visual acuity. J. W. T. W.

328. *The Opalescence of Binary Liquid Mixtures.* **J. C. K. Rav.** (Indian Assoc. for Cultivation of Science, Proc. 9. 1. pp. 19–60, 1924.)—Following a concise survey of work relevant to the subject the paper gives results of experimental and theoretical work on the scattering of light by binary liquid mixtures. Firstly, records are given in tabular form of the results of experiments for the measurement of the intensity and the state of polarisation of the scattered light obtained from mixtures of toluene and acetic acid at 30° C. and methyl alcohol and carbon bisulphide at different temperatures. In the case of the latter pair of liquids the intensity increases with concentration up to a maximum, after which it decreases with concentration increase. The effect is very marked at the critical temperature, whilst at the critical concentration the intensity is abnormally great, and is a maximum. At any given temperature there is a particular concentration for which the imperfection of polarisation is a minimum. This effect is more marked at the critical temperature where the scattered light is almost completely polarised for the critical concentration. At higher and lower temperatures the light becomes increasingly imperfect in polarisation.

Secondly, the subject is treated theoretically. Raman and Ramanathan's formula is derived by two methods: (1) By an electromagnetic theory of the scattering of light in binary liquid mixtures based on Lorentz' treatment of the scattering of light in gases without postulating a molecular structure; (2) the medium is assumed of molecular structure and the molecules to be isotropic. This treatment is also applied to anisotropic molecules, and it is shown that for molecules orientated entirely at random the transversely scattered light is imperfectly polarised. Finally a formula is deduced for the intensity of light scattered in a direction perpendicular to the primary beam.

Thirdly, the paper gives a comparison, by means of tables and curves, between theoretical and experimental results and shows fair agreement between the two. The method used is an adaptation of that proposed by and used by the same author in a previous work. [Abstract 252 (1924).]

S. G. B.

329. *The Feasibility of Cinema Projection from a Continuously Moving Film.* **H. D. Taylor.** (Optical Soc., Trans. 25. 4. pp. 149–174; Disc., 174–176, 1923–1924.)—The paper discusses the optical and mechanical problems involved in the production of screen pictures from a continuously moving film. The film picture may be reflected from a series of mirrors suitably mounted on a drum which is rotated at a definite speed relative to the motion of the film. The various oscillations that may be introduced on the screen image by such projection are discussed, and methods described for minimising or eliminating them. Calculations are made showing the relation that must exist between the back focal length of the projector lens, the number of mirrors, and the position of stops if definition is to be satisfactory. As compared with the usual type of projection, continuous projection results in a considerable saving of light, much reduced wear and tear of the film, complete freedom of light and dark flickering and consequent eye-strain, and much greater quietness in running.

AUTHOR.

330. *The Addition of Aberrations.* **T. Smith.** (Optical Soc., Trans. 25. 4. pp. 177–199, 1923–1924.)—The evaluation of the aberration coefficients of a complex system in terms of those of its components is investigated on a general basis which is independent of special properties of the system. For example, in an axially symmetrical system the refracting surfaces may be any surfaces of revolution, or the media may be non-homogeneous as long as they are homogeneous for all circles normal to and centered on the axis. Two methods are employed. The first, by successive approximation applied to equations of reduced order, is utilised to obtain the well-known results for the six first order aberrations and the comparatively unknown results of the ten second order aberrations. For higher orders this method becomes almost impracticable. The second method is based upon the evaluation of a function when it is stationary by Lagrange's theorem, and gives a theoretical solution to the problem for all orders. The results already obtained by the previous method are checked by this more general method, and the addition formulæ for the fifteen third order aberrations are also obtained. These are given in a simplified form free from all removable terms by the definition of a new function in terms of which the eikonal is expressed. The conditions for freedom from aberrations are given in terms of this function. AUTHOR.

331. *A New Perfectly Anallatic Internal Focussing Telescope.* **E. W. Taylor.** (Optical Soc., Trans. 25. 4. pp. 200–206; Disc., 206–208, 1923–1924.)—A new telescope is described which, while perfectly anallatic, is of the internal focussing type and combines the advantages of the Porro construction with those of the internal focussing telescope. AUTHOR.

332. *Note on a Convenient Bench for Testing Telescope Object Glasses.* **L. C. Martin.** (Optical Soc., Trans. 25. 4. pp. 209–212; Disc., 212, 1923–1924.)—A description is given of a sloping bench which is suitable for the familiar auto-collimation "star" test of telescope object glasses. Fine mercury globules scattered into black velvet are used to form artificial stars. AUTHOR.

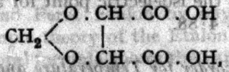
333. *The Measurement of Chromatic Aberration on the Hilger Lens Testing Interferometer.* **L. C. Martin** and **R. Kingslake.** (Optical Soc., Trans. 25. 4. pp. 213–218; Disc., 218, 1923–1924.)—An account is given of the experimental determination of the longitudinal chromatic aberration and secondary spectrum of telescope object glasses, using the Hilger lens testing interferometer. The amount of mirror displacement necessary to give the same interference pattern for different wave-lengths of light is measured by a screw micrometer. AUTHORS.

334. *Study of the Significance of the Foucault Knife-Edge Test when applied to Refracting Systems.* **(Miss) H. G. Conrady.** (Optical Soc., Trans. 25. 4. pp. 219–226; Disc., 226, 1923–1924.)—An attempt to explain the various appearances observed in the Foucault knife-edge test led to the construction of accurate three-dimensional models of pencils of light afflicted with aberrations present singly or in pairs. These models are based on equations for the geometrical interpretation of the Seidel aberrations. With their aid the test appearances are explained. AUTHOR.

335. *The Effect of Magnetic Fields upon the Polarisation of Resonance Radiation.* **F. Rasetti.** (Accad. Lincei, Atti, 33. ii. pp. 38–41, July, 1924.)—Wood and Ellett have recently described [see Abstract 1861 (1923)] some interesting observations on the effect of magnetic fields upon the polarisation of resonance radiation. They found that the resonance radiation normally observed with primary rays is usually polarised in a measure more or less strong. A magnetic field may destroy or augment the polarisation according to its direction and to the condition of polarisation of the primary ray. The intensity of field necessary to produce such effects is less than 1 gauss for mercury and about 100 gauss for sodium. The object of the present paper is to describe some experiment carried out upon mercury-vapour under different conditions from those employed by Wood and Ellett, and to show how all the observed facts may be repeated in a very simple manner and may be intimately connected with the Zeeman-effect and with the orientation of the atoms in the magnetic field. A. E. G.

336. *Double Slit Method of Examining Optical Systems.* **A. Merland.** (Rev. d'Optique, 3. pp. 401–413, Sept., 1924.)—Describes the method of studying optical systems by means of the interference fringes produced in the plane conjugate to a line source when a screen having two parallel slits is placed close to the objective of the system [see Abstract 1082 (1918) and Cotton (Physica, Oct., 1921)]. The apparatus used in applying the method is described in detail and some contour diagrams of certain lenses, obtained by this method, are reproduced. J. W. T. W.

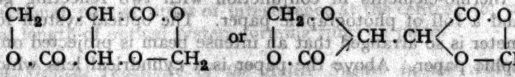
337. *Rotatory Dispersion of Derivatives of Tartaric Acid. Part I. Methylene Derivatives.* **P. C. Austin and V. A. Carpenter.** (Chem. Soc., J. 125. pp. 1939–1946, Sept., 1924.)—The rotatory dispersion of methylene tartaric acid,



$$CH_2\left\langle\begin{array}{l} O\,.\,CH\,.\,CO\,.\,OH \\ \qquad | \\ O\,.\,CH\,.\,CO\,.\,OH, \end{array}\right.$$

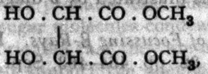
in aqueous solution at 20°, can be expressed by *one* term of Drude's equation as follows: $[\alpha] = -\ 24{\cdot}627/(\lambda^2 - 0{\cdot}0446)$. This formula for a solution containing 31·93 grammes of $C_5H_6O_6$ in 100 c.c is almost identical with that for a solution containing only 6·288 grammes in 100 c.c

The rotatory dispersion of dimethylene tartrate,



in ethyl acetate (9·80 grammes of $C_6H_6O_6$ in 100 c.c. of solution) at 20° can be expressed by the equation $[\alpha] = +\ 34{\cdot}168/(\lambda^2 - 0{\cdot}03122)$. An almost identical equation expresses the rotatory dispersion in acetone (5·10 grammes of $C_6H_6O_6$ in 100 c.c. of solution) at 20°.

In view of the fact that methyl tartrate,



$$\begin{array}{l} HO\,.\,CH\,.\,CO\,.\,OCH_3 \\ \qquad\;\; | \\ HO\,.\,CH\,.\,CO\,.\,OCH_3, \end{array}$$

exhibits anomalous rotatory dispersion which is expressed by *two* terms of Drude's equation of opposite sign, it is remarkable that the rotatory dispersion of these methylene derivatives is simple. This may be ascribed either to the elimination of the hydroxylic hydrogens in the methylene derivatives or to the locking of the two asymmetric carbon atoms by mean of ring-systems. T. M. L.

338. *Dispersion and the Correspondence Principle.* **G. Wentzel.** (Zeits. f. Physik, 29. 5. pp. 306–310, 1924.)—Dispersion is first discussed from the classical and quantum standpoints, since the general opinion prevails that the dispersion formula of the classical electronic theory is rigidly true under all circumstances and therefore should be derivable on quantum grounds [see Abstracts 2071 and 2978 (1924)]. Although a consequent quantum theory of dispersion cannot yet be given, nevertheless the correspondence principle appears to indicate a deviation from the classical dispersion formula, which conclusion is also supported by available experimental data in the expected direction. The paper is entirely mathematical. H. H. Ho.

339. *Mutarotation.* **R. Kuhn and P. Jacob.** (Zeits. phys. Chem. 113. pp. 389–431, Nov. 20, 1924.)—The velocity of mutarotation of glucose in presence of acids and alkalies can be explained on the assumption that the sugar has an acid dissociation-constant $10 \cdot 5 \times 10^{-13}$ and a basic dissociation-constant $7 \cdot 8 \times 10^{-17}$ at 25°, the ionic product for water at this temperature being $1 \cdot 27 \times 10^{-14}$. The velocity constants for the mutarotation of the acidic form of the sugar is then 113·2, for the basic form 544, and for the neutral molecules 0·0104. This leads to the equation $k = 0 \cdot 0104 + 0 \cdot 334[\mathrm{H}^{\cdot}] + 9345[\mathrm{OH}']$ as compared with Hudson's empirical equation $k = 0 \cdot 0096 + 0 \cdot 258[\mathrm{H}^{\cdot}] + 9750[\mathrm{OH}']$. The minimum velocity of mutarotation is given by this equation at an acidity $p_h = 4 \cdot 72$, whilst the isoelectric point for a solution of the sugar is calculated to be at $p_h = 4 \cdot 88$. T. M. L.

340. *Photographic Recorder for Temperature and Other Physical Quantities.* **W. H. Stannard and P. E. Klopsteg.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 587–598, Nov., 1924.)—The instrument described is intended for the simultaneous recording of data on a number of variables over long periods of time. It is applicable to the study of any problem in which it is possible to obtain galvanometer deflections as known functions of the variables in question. The plan adopted employs thermo-elements in conjunction with two reflecting galvanometers and a roll of photographic paper. The optical system for each galvanometer is so arranged that an intense beam is projected on to the photographic paper. Above the paper is a cylindrical lens which concentrates the beam of light to a small spot. Time lines are produced by means of a signal lamp which shows once a minute. The other scale of coordinates is produced by breaks in this line, caused by the shadows of the teeth on a calibrating bar. The paper roll is 100 ft. in length. It travels through a developing tank, a rinser, and is then dried and rolled on a spool. The paper is illustrated by 5 diagrams. E. G.

341. *Helical Method of Focussing β-Rays.* **R. A. R. Tricker.** (Cambridge Phil. Soc., Proc. 22. pp. 454–463, Sept., 1924.)—In this method, as suggested by Kapitza, a short-line source of β-rays is placed in a uniform magnetic field, parallel to the lines of force, and rays, projected at a given angle to the field, are selected by means of an annular slit, whose axis contains the source. These rays are spread out into a magnetic spectrum, which focusses on a film lying along the axis of the slit, at a suitable distance from the source. Owing to the difficulty of seeing faint lines, the method has disadvantages for obtaining β-ray spectra, but as compared with previously employed methods it has the advantages of large dispersion, uniformity and ease of reproduction of the magnetic field, good screening from γ-rays and secondary β-rays, axial symmetry, and greater intensity. A description and diagram of the apparatus employed are given, the design and conditions and errors of adjustment being made the subject of a theoretical study. A. B. C. L.

342. *Rapid Method of Tracing Rays through an Optical System.* **G. Slussareff.** (Rev. d'Optique, 3. pp. 441–458, Oct., 1924.)—This method enables calculations to be made to the same accuracy as with five-figure tables, but in very much less time. A formula is obtained connecting $\sin i$ for a surface with that for the preceding surface and $\sin u$ for the intervening medium. This formula is of the type $\sin i_{(j+2)} = C_j \sin i_j + C'_j \sin u_{(j+1)}$. Passage from $u_{(j-1)}$ to $u_{(j+1)}$ is effected by means of special nomographs giving $\sin u_{(j+1)}$ when $\sin u_{(j-1)}$ and $\sin i_j$ are known. Copies of these nomographs may be obtained from the Institut d'Optique, Paris. J. W. T. W.

343. *Fabry and Perot Etalon.* **J. K. Robertson.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 611–615, Nov., 1924.)—The author considers that in the teaching of physical optics it is desirable that quantitative measurements in the laboratory should go hand in hand with formal lectures. In this paper are reported a series of experiments involving quantitative measurements which can be conveniently carried out with a Fabry and Perot Etalon by any advanced student. The author quotes the simple theory of the Etalon and by various transpositions of the fundamental formula shows the varied information obtainable from a photograph of the rings. Light from a mercury vapour lamp suitably filtered is roughly condensed on the Etalon and the resulting system of fringes photographed with the camera attachment of a Hilger constant deviation spectroscope. The various measurements are as follows: (1) The constancy of the difference of the squares of the diameters of successive rings; (2) the change in wave-length which corresponds to a shift of one fringe; (3) thickness of the Etalon; (4) fractional part of order of interference at the centre; (5) calculation of focal length of optical system forming rings on plate. F. S. B.

344. *Optical Inactivity of the Active Sugars in the Adsorbed State.* **S. S. Bhatnagar** and **D. L. Shrivastava.** (J. Phys. Chem. 28. pp. 730–743, July, 1924.)—In presence of adsorbing colloids, such as arsenic and antimony sulphides, the rotatory powers of optically active sugars are less than the values calculated according to Beer's law, the discrepancies increasing as the ratio between the proportions of sol and sugar increases. It appears probable that such decrease in rotation is due to the fact that the sugar molecules condensed on the surface of the colloidal particles are so oriented that they are no longer optically active. Thus the results obtained support the chemical affinity theory of the protective action of colloids, and further support is furnished by qualitative analysis of the adsorbent. T. H. P.

345. *Archæology from the Air.* **O. G. S. Crawford.** (Nature, 114. pp. 580–582, Oct. 18, 1924.)—The author of this article, who has been instrumental, largely in taking advantage of the unique facilities afforded by aerial photography in recording hitherto unobserved archæological facts, describes the early history of balloon and aeroplane photography, and proceeds to recount some of the discoveries made in the neighbourhood of Winchester of Celtic fields, lynchets and ditches, by examination of vertical aeroplane photographs. The greater part of the article describes the results of systematic aerial photography in the Stonehenge district, the results of which indicate clearly that ancient roadways, ditches and boundaries, earthworks and avenues, can often be traced from photographs. The colour changes, as viewed from the air, are also indications of the existence of such prehistoric topographical features as filled-up ditches and roads. The changes observed in the vegetation on ancient sites are stated to be fairly reliable guides in tracing these sites. The article is illustrated with a number of reproductions of aerial photographs showing certain archæological discoveries from the air. A. W. J.

346. *The Average Quantity of Ultra-Violet Light Energy Required to Render Developable a Grain of Photographic Silver Bromide.* **P. S. Helmick.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 521–540, Nov., 1924.)—Describes the work of previous investigators, including the author's earlier researches, in which he found that about 2×10^7 incident quanta of mean wave-length 5490 Å. were required to render developable a grain of silver bromide. The present paper is an account of an extension of the earlier investigation into the near ultra-violet region. For wave-lengths of 2537 Å. to 3650 Å., it was found that the general average quanta per grain ranged from 731 ± 14 to 555 ± 13. An appendix refers to the reflecting and absorbing power of a photographic emulsion. A. W. J.

347. *Studies with the Microbalance. Part I. The Photo-chemical Decomposition of Silver Bromide.* **E. J. Hartung.** (Chem. Soc., J. 125. pp. 2198–2207, Nov., 1924.)—The photochemical decomposition of silver bromide was studied by Volmer in 1910, who used a delicate bending-rod balance, and found that films of the halide might lose as much as 40 per cent. of the total bromine on illumination. More recently Strömberg, Koch and Schrader have experimented on the same subject; the latter used apparatus which was sensitive to 1 per cent., and only insignificant alterations in weight were detected after considerable exposure to light. The author of the present paper has studied the same problem by means of two Scheele-Grant microbalances, one carrying 105 mg. and the other 43 mg.; both instruments were sensitive to 2×10^{-5} mg. The general procedure adopted was to prepare thin silver bromide films by brominating silvered vitreous silica supports; these were then exposed to sunlight in evacuated glass vessels, the stoppers and taps being well greased. In later experiments very pure silver bromide films were made, and the use of lubricant in the apparatus dispensed with. The preparation of these films is described in detail, and also the experimental apparatus used to test and measure the photochemical decomposition of silver bromide in a vacuum. Tabular results are given. The rate of bromination of silver films was also studied, and a series of results in both tabular and graphical form are given in the paper. The results of these researches showed that more than 96 % of the bromine may be expelled from pure silver bromide films by insulating thin films of silver bromide in a vacuum in the presence of a suitable halogen absorbent. It was also ascertained from the investigation on the rate of bromination of thin silver films that there was no evidence of the formation of silver subbromides. A. W. J.

348. *On the Doppler Effect during the Transformation of Resonance Fluorescence at Reflection.* **W. Rump.** (Zeits. f. Physik, 29. 3–4. pp. 196–208, 1924.)—In this paper it is established that in the case of resonance fluorescence the re-emitted line possesses a greater Doppler width than the incident line when the secondary resonance lamp has a higher temperature than the primary one. At reflection, on the other hand, the reflected radiation is not widened whether the reflection takes place at glass, metal, or mercury vapour. Such investigation of the Doppler effect is found to enable the transformation of fluorescence at reflection to be followed directly. H. H. Ho.

349. *The Total Radiation of the Luminous Part of the Nernst Lamp at Different Temperatures.* **E. Wiegand.** (Zeits. f. Physik, 30. 1. pp. 40–49, 1924.)—The total radiation of the luminous part of the Nernst lamp has been measured between 1000 and 2300°, that of uranium oxide U_3O_8 between 900 and 1440°, and the results compared with the radiations from platinum and tungsten. From all data available it follows that high radiation capacity is combined with good conductivity, and this relationship appears of general significance. Experimental details with copious data are included. H. H. Ho.

350. *Quantum Radiation.* **R. de L. Kronig.** (Zeits. f. Physik, 29. 6. pp. 383–386, 1924.)—Wentzel showed in his paper [Abstract 1435 (1924)] that the classical interpretation of phase is endorsed by the quantum theory. It is shown therein that if a radiation process is considered which commences with the emission (E) of the light quantum from an atom and ends with the absorption (A) of the light quantum by another atom, the invariable expression for the phase of the radiation is given by the expression $\phi = \frac{1}{h}\sum_{K}\int\beta_K \,.\, d\alpha_K$, whereby the emitting atom, the absorbing atom and all atoms influenced by the light quantum along its path are considered together as a mechanical system. The present paper shows that this definition of phase is erroneous and it must be so altered that the result deduced by Wentzel will hold for all conditions included in the classical definition of phase. These conditions are satisfied by the alteration of the above expression for the phase to $\phi = \frac{1}{h}\int[2t \,.\, dW \,.\, - \sum_{K}\beta_K \,.\, d\alpha_K]$. The result is interpreted in the sense of the comprehensions of Bohr, Kramers and Slater for the virtual field of radiation. The paper is mathematical throughout. S. G. B.

351. *Visible Radiation from Solid Targets.* **P. D. Foote, W. F. Meggers and R. L. Chenault.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 541–543, Nov., 1924.)—Considerations of the quantum theory suggest that it should be possible to excite a visible or ultra-violet line spectrum from a solid target by bombarding it with electrons. The lines might be due to perturbations of valence electrons or, more probably, be X-ray lines of low frequency arising from disturbances deep down in the atom. Bombardment with 1000-volt electrons has been tried for targets of copper, carbon, platinum and iron in an X-ray bulb of pyrex glass with a sealed-in quartz window. In spite of all precautions of vacuum technique, the same spectrum, as obtained with a quartz spectrograph, was found with each target. The more prominent bands correspond to the first negative carbon group of Deslandres, but are enhanced by the presence of nitrogen. The experiments are negative in demonstrating line emission from solid targets. F. S.

352. *Absorption of Near Infra-red Radiation by Alums.* **S. Higuchi.** (Tôhoku Univ., Sci. Reports, 12. pp. 359–363, July, 1924. In English.)—It was first believed that a substance containing the water of crystallisations shows absorption bands identical in their positions with ordinary water in the infra-red region. But Schäfer concludes from his experiment under a detailed observation that some characteristic vibration of the crystal water different from that of ordinary water can be detected, the maxima of the absorption being a little shifted, and that in an anisotropic crystal the crystal water is also anisotropic, this being due to the chemical binding of the crystal water in the structure. In the case of alums, the reflection maximum has two peaks, their positions being the same for all the alums tried. The first peak is a little displaced towards the longer wave-length side as compared with that of ordinary water, and the other, corresponding to these two peaks, are $\lambda_1 = 3\cdot 5\,\mu$ and $\lambda_2 = 3\cdot 05\,\mu$, that of ordinary water being $\lambda_0 = 3\cdot 15\,\mu$. In the present experiments the water of crystallisation in alums shows characteristic double frequencies corresponding to $\lambda_1 = 3\cdot 43\,\mu$ and $\lambda_2 = 3\cdot 04\,\mu$, a result which almost coincides with that of Schäfer. A. E. G.

353. *The Infra-red Absorption of Ice.* **E. K. Plyler.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 545–555, Nov., 1924.)—The absorption of ice is dependent upon the direction of the plane of polarisation for the near infra-red region. Crystals were cut with the optic axis parallel to the surface. Plane polarised radiation was allowed to fall upon the crystal and the per cent. transmission determined. The crystal was set in three positions: first, so that the transmitted radiation constituted the ordinary ray; second, so that the transmitted radiation constituted the extraordinary ray; third, so that the incident energy was about equally divided into two rays. For the first position, with a thickness of 5 mm., absorption bands were observed at the following wave-lengths with the corresponding per cent. transmission: $0\cdot 81\,\mu$—55 per cent., $0\cdot 92\,\mu$—54 per cent., $1\cdot 06\,\mu$—46 per cent., $1\cdot 29\,\mu$—27 per cent. For the second position the values were: $0\cdot 79\,\mu$—93 per cent., $0\cdot 89\,\mu$—94 per cent., $1\cdot 02\,\mu$—93 per cent., $1\cdot 26\,\mu$—57 per cent. For the third position the transmission curve fell between that of the first and second positions and showed both sets of bands. The region from $1\cdot 4\,\mu$ to $1\cdot 7\,\mu$ was studied by using a specimen 1 mm. thick. The position of maximum absorption was located at $1\cdot 5\,\mu$. The incident energy was unpolarised. AUTHOR.

354. *The Ultra-red Absorption Spectrum of Ammonia.* **K. Schierkolk.** (Zeits. f. Physik, 29. 5. pp. 277–287, 1924.)—The absorption spectrum of ammonia has been measured within the range $0\cdot 589\,\mu$ to $14\cdot 4\,\mu$. In addition to the bands recorded by W. W. Coblentz, a series of very intensive bands have been established, while those of Coblentz at $3\cdot 0\,\mu$, $6\cdot 0\,\mu$, and 8—$15\,\mu$ have been still further resolved. Some data are given for the moments of inertia of the ammonia molecule. Full experimental details with data and diagrams are included. H. H. Ho.

355. *Ultra-Violet Spectro-Photometry.* **T. R. Merton.** (Roy. Soc., Proc. 106. pp. 378–384, Oct. 1, 1924.)—The method previously worked out [see Abstract 1132 (1917)] for the measurement of the relative intensities of spectrum lines by a neutral wedge is limited in range by the fact that the glass wedge is opaque to the ultra-violet. It has now been found that thin wedges of platinum deposited on plates of quartz show small variations of density gradient with wave-length, and can be used from the red end of the spectrum down to λ2100 Å. The method of preparation of such wedges by sputtering is described, and also the calibration for density gradient along the wedge and as a function of the wave-length. For the former calibration a glass spectrograph was used with a very coarse diffraction grating placed between the prism and camera lens, and comparison made with a glass wedge; while for the latter a Hilger quartz spectrograph was employed and two photographs of the quartz mercury-arc taken through the platinum wedge, a clear quartz plate being placed near the condensing lens in the first case, and one covered with lampblack and ruled with parallel lines so as to reduce intensity by a known amount in the second. The density gradient is sensibly constant from 4000 Å. to 2500 Å. F. S.

356. *Absorption and Dispersion of Thallium Vapour.* **A. L. Narayan, D. Gunnayya and K. R. Rao.** (Roy. Soc., Proc. 106. pp. 596–601, Nov. 1, 1924.)—The chief difference between the spectra of metals of Group III and those of the first two groups is that the convergence frequency of the principal series is smaller than that of the subordinate series. According to Grotian and to Carroll [Abstract 2173 (1923)], the ground orbit of the valence electron in this group is $1, \pi$, and not $1, \sigma$ as in the case of other metals. The apparatus used by the authors was the same as that employed for potassium vapour; the tube was heated in a charcoal furnace and was evacuated. Photographic reproductions of the absorption spectrum show that the non-luminous vapour of thallium absorbs lines of the sharp and diffuse series; at high temperatures a large number of absorption lines and bands appear, probably due to Tl_2 molecules. Band λ3775 is sharply defined on the short wave-length side, but gradually spreads towards the red with increasing density of the vapour; there is a banded spectrum from λ3260 to λ3220 at high temperatures, probably identical with a group of lines observed by Carroll. Lines and bands λ2768, λ2843, λ2847, λ2670, λ3095 to λ3135, and λ4500 to λ5000 are described. The following table gives the lines to which designations have been assigned:

5350·46	$1, \pi_1 - 1, \sigma$	3529·43	$1, \pi_1 - 2, \delta'$
3775·72	$1, \pi_2 - 1, \sigma$	3519·24	$1, \pi_1 - 2, \delta$
3229·75	$1, \pi_1 - 2, \sigma$	2767·87	$1, \pi_2 - 2, \delta$
2580·14	$1, \pi_1 - 2, \sigma$	2921·52	$1, \pi_1 - 3, \delta'$
2826·16	$1, \pi_1 - 3, \sigma$	2918·32	$1, \pi_1 - 3, \delta$
2315·93	$1, \pi_2 - 3, \sigma$	2379·58	$1, \pi_2 - 3, \delta$
2665·57	$1, \pi_1 - 4, \sigma$	2847·00	$1, \pi_2 - 2, \pi_1$?

Hilger's rock-salt spectrometer was used in the near infra-red to find whether the single-line spectrum of the element $(1, \pi_2 - 1, \pi_1)$ was absorbed. Both visual and photographic observations show that there is no selective absorption in this region, so that $1, \pi_2 - 1, \pi_1$ is probably not the single-line spectrum of the metal. It is probably excited under electronic bombardment. Experiments were carried out, visually and photographically, with crossed prisms to investigate anomalous dispersion in the vapour; none was found at 6000 Å. where Geissler observed it, a feeble effect was found at 5350·6 Å. (Geissler and McLennan), and a more prominent one at 3775·7 Å. This agrees with the fact that 1, π_2 is the fundamental orbit of the atom, since the lines with 1, π_2 as their first terms are absorbed at lower temperatures than the others. H. N. A.

357. *Absorption of Electrically Luminescent Potassium Vapour.* **A. L. Narayan and G. Subrahmanyam.** (Indian Assoc. for Cultivation of Science, Proc. 9. 1. pp. 15–18, 1924.)—In order that a vapour may absorb light corresponding to a given series in its spectrum there must be a large number of atoms with orbits corresponding to the first term of the pulse to be absorbed. The Bergmann series is therefore absorbed at high temperatures, when the sharp series is emitted. This can be tested by keeping the vapour feebly luminescent instead of by raising to high temperature. A glazed porcelain tube 50 cm. long wound with a heating coil was used. It was provided with platinum electrodes and plane glass windows kept cool by water jackets. To avoid disturbance of the Paschen galvanometer used with a mirror spectrometer, the tube was placed 30 ft. from the instrument and a beam of sunlight focussed through it. With the tube at 350° C. and no discharge, the first members of the diffuse and sharp series of potassium at 1·18 μ and 1·25 μ were observed, and also the first two members of the Bergmann series at 1·52 μ and 1·1 μ. When the discharge was passed, lines at 0·58 μ and 0·53 μ belonging to the diffuse and sharp series were also emitted and there was no appreciable absorption of the lines at 1·25 μ and 1·17 μ. There was a distinct absorption of the first Bergmann member at 1·5 μ, the galvanometer deflection being reduced from 12·4 cm. to 11·3 cm. F. S.

358. *An Absorption Line of the Iodine Atom.* **C. Füchtbauer, F. Waibel and E. Holm.** (Zeits. f. Physik, 29. 6. pp. 367–371, 1924.)—The paper describes the results of experiments on the absorption spectrum of iodine vapour heated in a closed space to temperatures varying from 540° to 1050° C. The source of light was a zinc spark and the spectrum was examined using a quartz spectrograph having a dispersion of 2·99 Å.U. per mm. in the region of 2060 Å.U.

At 2062·1 Å.U. an absorption line of the iodine atom was found, the line being broadened by the addition of argon at three atmospheres pressure, but is still fairly faint and narrow. For higher temperatures (*e.g.* 1050° C.) the photographs show the line distinctly, but it disappears on cooling the iodine in solid CO_2, while at 540° C. it is still no longer visible, indicating its connection with the iodine atom. A photograph of the band-spectrum of air at higher temperatures (1050° C.) is also reproduced. W. V. M.

359. *The Absorption Spectrum of the Neutral and Ionised Cadmium Atom in the Water-immersed Spark Discharge.* **H. Stücklen.** (Zeits. f. Physik, 30. 1. pp. 24–39, 1924.)—The method of obtaining the absorption spectrum of a metal from that in the water-immersed spark discharge is first discussed in detail. A vapour mantle is found to form around the spark nucleus which for the greater part contains neutral but also some ionised atoms derived from the metallic electrodes. The discharge nucleus itself gives a continuous spectrum which, however, is not caused by H^+ ions as often assumed. The immersed spectrum of cadmium exhibits emission and absorption lines upon a continuous background, all the latter lines and the great majority of the former belonging to the series system. Experimental conditions are described whereby the number of the absorption lines appearing can be raised from zero to a maximum. Their appearance is favoured by increase of frequency, diminution of potential, and extension of the electrode diameters. Conclusions are drawn from the absorption line series as to the succession of states which the atom experiences through external excitation. The under-water spectrum of cadmium was found divisible into six groups. The absorption lines most readily produced in the arc and spark spectra correspond to the passage of the electron in the neutral and in the ionised atom from the normal orbit into the next higher. As normal orbits of the valence electron in the neutral and ionised atoms, the 1S and $1\mathfrak{S}$ have been found espectively, the next most probable being the 2P and $2\mathfrak{P}_{1,2}$. The resonance lines 1S—2P are obtained readier in absorption than the resonance lines 1S—$2p_2$. H. H. Ho.

360. *Absorption Spectra and Coordination of Some Cupric Compounds.* **H. S. French** and **T. M. Lowry.** (Roy. Soc., Proc. 106. pp. 489–512, Nov. 1, 1924.)—The question of coordination of a metallic derivative of an organic compound is usually determined by such tests as solubility. As such tests fail in such a case as the copper salts of fatty acids, the higher homologues having quite different solubilities from the lower ones, it was decided to see if the absorption spectrum could be used as a test. Measurements in the visible spectrum by means of a Nutting photometer have been extended into the ultra-violet and near infra-red, and it is shown that the absorption-spectra of the cupric compounds, both organic and inorganic, are dominated by (1) a red or infra-red band, which is characteristic of the cupric atom; and (2) an ultra-violet band or general absorption, which depends mainly on the anion or organic radical. The colour of the cupric compounds depends on the character of the narrow region of transmission between these two absorptions. The conclusion is drawn that all the cupric compounds investigated are coordinated; but that, whilst some of the organic compounds are stable towards water, others are decomposed by it, yielding a hydrated cupric ion, which, however, is also coordinated. F. S.

361. *Fine Structure of the Band-Spectra of Sodium, Potassium, and Sodium-Potassium Vapours.* **H. G. Smith.** (Roy. Soc., Proc. 106. pp. 400–415, Oct. 1, 1924.)—The usual parabolic formulæ for band-spectra are applied to sodium and potassium bands and to the new mixed-molecule bands found by Barratt [Abstract 1167 (1924)]. These bands were ascribed by Barratt to a molecule NaK, which is fully confirmed by the author's calculation of the moment of inertia from the parabolic formulæ. As shown independently by Barratt and the author, these molecules are present in normal alkali vapours, though in small quantities.

The vapours were heated in pyrex-tubes over gas flames. Resolution in some cases was as good as 0·1 Å. Details of the band-line wavelengths and of the formulæ-constants are given in all three cases.

The moment of inertia of the sodium molecules appears to have at least two values, though the same observation has not been made in potassium. The values of the moments of inertia in grm. cm.^{2} × 10^{-39} are: Na_2, 2·518 and 2·286; K_2, 18·39; NaK, 6·615; while the calculated value for NaK from Na_2 and K_2 separately is 6·28 or 6·45, in sufficiently good agreement to confirm the hypothesis of mixed molecules. A. C. M.

362. *Vegard's Theory of the Aurora.* **R. d'E. Atkinson.** (Roy. Soc., Proc. 106. pp. 429–440, Oct. 1, 1924.)—A summary is given of Vegard's theory and of the experimental evidence on which it was based. [Abstracts 2104–2106 (1923), and 40, 2093, 2776 and 2778 (1924).] The presence of solid nitrogen at great heights is criticised on the grounds that (1) the electric field required to lift the crystals cannot be obtained from the sun's photoelectric or X-ray activity unless Vegard relies upon some unknown selective radiation capable of escaping from the outer layers of the sun's atmosphere, and yet being effectively stopped and converted in those of the earth's; (2) the improbably high electrostatic field to force the crystals up, obtained by Vegard, is much too small for the purpose, and the theory for the density gradient in the gas leads to a very small size for the nitrogen crystal; (3) the photoelectric action suggested by Vegard may probably be ruled out in an Arctic night, while α and β rays, acting on a crystal possessing a single charge, cannot give the auroral display, but large multiple-charged crystals possessing a large volume charge are required; (4) it is improbable that solid nitrogen can emit a spectrum containing a narrow line unless accepted theories for the emission of line spectra are radically unsound or incomplete; (5) the theory requires 4×10^{10} quanta per second emitted continuously from each crystal instead of a probable one for its whole life. The evidence for the formation of solid nitrogen is discussed, and it is shown only to be possible if we get selective absorption in a band beyond 100 μ. This, however, is disproved in that it requires the establishment of an adiabatic gradient extending to the ground and prevents the occurrence of the isothermal region. The experimental evidence of Vegard's for his theory is inconclusive, and Lindemamn and Dobson's results for densities and temperatures in the upper air are opposed to the theory. Two alternative theories are outlined for the aurora produced in a purely gaseous mixture: (1) By assuming the existence of Vegard's electric field; and (2) by assuming the crystal charge is a difference one and employing a lower and more probable field. Experiments are outlined, made to detect the auroral line 5578° Å., and these lead to the conclusion that oxygen may be the cause, and not nitrogen. The possibility of this being the case for the aurora is discussed. R. S. R.

363. *Appendix to the Paper on Intensities of the Components in the Zeeman-Effect.* **L. S. Ornstein** and **H. C. Burger.** (Zeits. f. Physik, 29. 3–4. pp. 241–242, 1924.)—This mathematical note contains an alternative generalisation of the Burger-Dorgelo intensity law for multiplets, leading exactly to the same results as the previous generalisation. [See Abstract 103 (1925).] H. H. Ho.

364. *Disturbance of the Zeeman-Effect by Electric Fields.* **H. C. Urey.** (Zeits. f. Physik, 29. 2. pp. 86–90, 1924.)—The author considers the effect of mutually perpendicular electric and magnetic fields on the electron circulating round a positive core, as in the hydrogen and ionised helium atoms. It is then found that if the fields be so arranged that $\sigma \pm \rho = 0$, where σ is the relativity precession of the ellipse frequency, and ρ is the Zeeman effect frequency, the lines will be widely displaced. This result is not to be expected for circular orbits ($n = k$), and so lines must be chosen which involve ellipses, *e.g.* the second strongest components in H_α and λ4686 He. Higher members of the Balmer series have their strongest components due to elliptical orbits, but they are unfortunately less affected by electrical fields. The difficulties in the way of experimental verification are discussed, and the f-levels in parhelium are suggested as providing the easiest material. A. C. M.

365. *Some Recent Researches on X-Rays: The J Phenomenon.* **C. G. Barkla.** (Nature, 114. pp. 753–755, Nov. 22, 1924. Summary of the Silvanus Thompson Lecture delivered before the Röntgen Society.)—The paper is an important statement of the present position of the J radiation problem. The J phenomena are briefly these: As the frequency of an X-radiation gradually increases, though there is in general an increase in the penetrating power of the radiation, under certain conditions, the absorption in a given substance exhibits a discontinuity, rising abruptly to a higher level, and always diminishing, as previously, with increasing frequency of the radiation. The absorption discontinuity occurs at a slightly higher frequency the higher the atomic number of the absorber. The sudden increase in the absorption is accompanied by increased ionisation in the absorber. The effects distinguishing the J phenomena from the emission of a characteristic radiation are: (1) The phenomena are conditioned by some unidentified factor, whereas the only condition essential to X-ray fluorescence, as previously known, is Stoke's law; (2) the sudden changes are abrupt, even when a heterogeneous primary beam is used; (3) the point at which the discontinuity occurs appears to be more closely connected with the rate of absorption of energy than with a critical wave-length; (4) the series of critical wave-lengths for various absorbers cuts right across the K series of the elements. The experimental evidence for (3) is given, including the fact that the absorption discontinuity does not appear when thin absorbing sheets are used, whereas the discontinuity does appear when the absorption is measured by means of thick sheets, the critical thickness under certain conditions being obtainable. The phenomena have many applications to the scattering of X-rays. It appears that the transformed radiation is neither a fluorescent radiation nor a scattered radiation, and various facts are cited as contrary to Compton's hypothesis. Thus the wave-length of the scattered radiation remains the same as that of the primary over a long range of wave-lengths, the apparent change appearing quite abruptly as the frequency increases. There are several well-marked discontinuities, and when thick sheets are used to test the character of the radiations, the discontinuity appears when the primary is of greater wave-length than is the case when thin sheets are used. Thus there is the appearance of a sudden absorption of the primary beam, followed by a re-emission of radiation of somewhat greater wave-lengths proceeding in the direction of propagation. No direct evidence of the emission of a characteristic J radiation has been obtained, and the conditions under which the J phenomena appear are still unknown. The report is itself summarised, and should be consulted for further information. W. V. M.

366. *Measurements of X-Ray Constants.* **K. Lang.** (Ann. d. Physik, 75. 5. pp. 489–512, Oct., 1924.)—The subject of precision X-ray spectra measurements is considered, reference being made to the work of Siegbahn, Weber, Vogel and others. Weber has shown that the copper $K\alpha_1$ line can be used as a standard.

A precision X-ray spectrometer employing the Seemann slit method is then illustrated and described, together with a metal water-cooled

X-ray tube, specially designed for experimental work. Precision measurements with these apparatuses for various spectral lines of the following elements are then tabulated: copper, iron, cobalt, nickel, zinc, palladium, silver, cadmium, tin, osmium, irridium, platinum, gold, lead and bismuth. These results are then compared with those of other observers, the source of errors discussed, conclusions drawn of the values of v/R and $\sqrt{v/R}$, and the relative advantages of the Bragg and Seemann spectrometers. B. J. L.

367. *The Refractive Index for X-Rays and the Deviations from Bragg's Law of Reflexion.* **P. P. Ewald.** (Zeits. f. Physik, 30. 1. pp. 1–13, 1924.)—B. Davis and his students have measured the deviations from the Bragg law with great accuracy by a new method; he has explained his results in terms of Stenström's equation, which assumes that the X-rays have a velocity $q = C/\mu$ in the interior of a crystal, where μ is the refractive index for X-rays [Abstracts 1486 and 2524 (1924)]. In spite of the remarkable results thus obtained, the author considers that the theoretical foundations made use of are not quite satisfactory. The relations are not as simple with X-rays as with ordinary light in an isotropic medium, where the refractive index is a well-defined constant of the material. Even with light a single constant does not suffice in many crystals (double refraction), and the slow changes in the refractive index for light with direction in crystals become very sudden changes in the case of X-rays; thus the ordinary dispersion formula loses its applicability. The author, however, shows that his dispersion theory of X-ray interferences [Abstract 950 (1918)] enables the B. Davis measurements to be dealt with satisfactorily—of course, on the classical basis. The approximations of B. Davis and v. Nardroff prove to be justifiable. H. N. A.

368. *Consumption of Energy on Ionisation of Air by X-Rays of Different Wave-lengths.* **L. Grebe** and **L. Kriegesmann.** (Zeits. f. Physik, 28. 2. pp. 91–94, 1924.)—Comparative tests made, using a method which reduces energy-measurement to current-strength measurement. With decreasing wave-length the energy-consumption increases exponentially. A. D.

369. *Investigation of Recrystallisation by Means of X-Rays.* **R. Glocker** and **E. Kaupp.** (Zeits. f. Metallkunde, 16. pp. 377–379, Oct., 1924.)—Diagrams (photographic) are given showing the X-ray interference patterns obtained with a plate of rolled silver, in which a definite crystallographic direction, coinciding with the direction of rolling, is made evident, the fibre structure of Polányi, and with the same plate, after heating, for different periods to different temperatures. Heating to 125° C. for ten minutes did not alter the X-ray diagram, but the same period at 140° gave some signs of the commencement of recrystallisation, black pin-pricks appearing in the diagram; 150° made these more numerous, owing to the formation of larger crystallites; the original "rolling" diagram is, however, still distinct. At 170° some of the intensity maxima of this diagram begin to disappear, and it is evident that a large proportion of the crystallites have now left the structure peculiar to rolled metal. A similar result is obtained by heating for fifty minutes to 150°, and it is not possible at this temperature, even after heating for a whole day, to arrive at a perfectly irregular orientation of the crystallites. The nature of the new orientation produced by heating to a low temperature, or to a high temperature for a short time, has been worked out quantitatively. While in the unheated rolled specimen the [112] direction is parallel to the direction of rolling, and an edge of the elementary cube lies in the plane of the rolling, inclined on one side or the other to the [112] direction, the [112] direction remains as before in the new orientation, but the cube edge is shifted out of the plane of rolling, and occupies one of four positions, which are symmetrical with respect to the [112] direction and the plane of rolling. H. N. A.

370. *X-Ray Analysis of Coal.* **C. N. Kemp.** (Soc. Chem. Ind., J. 43. p. 234, 1924. Brit. J. of Radiology, 20. pp. 174–176; Disc., 176–177, Oct., 1924.)—This paper has been practically covered [see Abstract 1065 (1924)]. F. J. B.

371. *The Action of X-Rays on Certain Organic Ferments and Cells.* **Guilbert, R. Petit and M. Lemay.** (Arch. d'Él. Médicale, 32. pp. 309–315, Oct., 1924.)—Details of experimental researches upon the above subject are given and the following conclusions drawn: (1) Whilst with weak doses there is no action, with strong doses of X-radiation the organic ferments (of the liver, etc.) are momentarily paralysed, but not destroyed; (2) a chemical body, as adrenaline, is definitely destroyed; (3) polynuclear blood cells usually considered as very radio-sensitive resists, in artificial media, considerable doses of X-radiation, but, when in histological relation to the general and complex actions of the organism, they appear to undergo a karyokinesis. For the first time such living cells have been preserved and cultivated in collodion sacs, and should so be of value for other experiments. It is necessary to be cautious in deducing such non-destruction of polynuclears—for example, in carcinoma cells—and it should not be forgotten that such cells have a defensive function, the rôle of which is not clearly defined. The destruction of carcinoma cells appears to be due to physical ionisation, but the phenomenon appears to be very complex. From the point of view of practical radiology the paralysis of hepatic catalysers and the destruction of adrenaline draws attention to dangers of irradiation in the hepatic and suprarenal regions. The authors consider the paralysis and destruction of the organic ferments as the cause of pernicious anæmia, asthenia, and early death when the hepatic, splenic and lumbar regions are irradiated. B. J. L.

RADIO-ACTIVITY.

372. *Radio-activity of Gases emitted from Vesuvius.* **J. Stoklasa** and **J. Penkava.** (Comptes Rendus, 179. pp. 819–822, Oct. 27, 1924.)—Measurements made by means of Gerdien's apparatus of the electrical conductivity of the gases emitted from the crater of Vesuvius and from the recently formed crater of Forum Vulcani show a conductivity much higher than that of the ordinary atmosphere. The results obtained with gases after mixing with the air give values as high as $4\cdot8 \times 10^{-4}$ e.s. unit, and the conductivity of the gases at the moment of emission is certainly much greater than this. Even at the foot of Vesuvius the conductivity is as much as $1\cdot2 \times 10^{-4}$ e.s. unit, and at Pozzuoli and at Posillipo values have been obtained from $2\cdot4 \times 10^{-4}$ to $2\cdot6 \times 10^{-4}$ e.s. unit. These latter values are about the same as is found at Jáchimov (Joachimstal). At Mulhouse, above the deposits of potash, the conductivity was found to be $0\cdot8$ to $1\cdot0 \times 10^{-4}$ e.s. unit, while in the potash mines a value of $2\cdot8 \times 10^{-4}$ e.s. unit was obtained. The results tend to the conclusion that the conductivity of the gases emitted from Vesuvius and the neighbourhood is due to radio-active emanations. The latter part of the paper discusses the effect of these radio-active emanations in the development of leguminosæ, especially *Spartium fimceum* and *Robina pseudoacacia*, which are, on Vesuvius, the beginnings of the vegetation. Certain bacteria which assimilate the nitrogen of the atmosphere are stimulated in their activity by radium emanation, and these bacteria are found in all the soils of the Campanie as well as on Vesuvius. A. W.

373. *Radio-activity of Basalts and Other Rocks.* **J. H. J. Poole** and **J. Joly.** (Phil. Mag. 48. pp. 819–832, Nov., 1924.)—With the object of providing further data relative to the geological history of the earth's crust, the authors have carried out a very extensive series of measurements of the radium and thorium content of a large number of basic and ultra-basic rocks obtained from different parts of the world. It is considered that such rocks are likely to give a more reliable estimate of the radium content of the earth than any others. The general means for basaltic rocks are as follows:—

Source.	No. of Observations.	Radium.	Thorium.
All basalts, dolerites, gabbros	(58)	1·19	0·77
Hebridean basalts	(6)	0·77	0·49
European basalts	(15)	1·30	0·84
Deccan basalts	(6)	0·77	0·46
Western U.S.A. basalts	(7)	1·69	1·52
Atlantic islands	(8)	1·31	0·87
Indian Ocean islands	(3)	0·86	0·65
Pacific Ocean islands	(4)	1·09	0·32
Eastern U.S.A.	(5)	1·09	0·65
South African	(4)	1·44	0·70

The figures in the columns must be multiplied by 10^{-12} in the case of radium and by 10^{-5} in the case of thorium, the results being quantities found per gramme of rock. The bearing of these results is discussed, and the work is to be extended.

The ultra-basic rocks are somewhat lower in the mean than the basalts. A comparison of results for acid, intermediate, and basic rocks shows that the relation first found by Rayleigh is sustained. A. B. W.

374. *Radio-Activity of the Guérat Granite.* **P. Loisel.** (Comptes Rendus, 179. pp. 533–534, Sept. 15, 1924.)—Determinations on the emanation obtained from the granite of Guérat, Bagnoles-de-l'Orne, indicates the presence of substances of long life which have not yet been isolated. [Abstract 516 (1923).] W. A. R.

375. *X-Ray Tracks in a Strong Magnetic Field.* **P. L. Kapitza.** (Roy. Soc., Proc. 106. pp. 602–622, Nov. 1, 1924.)—When an α-particle moves in a magnetic field it describes a curved trajectory, the curvature of which is closely related to its charge and velocity. Thus the track of an α-particle in a Wilson expansion chamber, placed in a magnetic field, will be no longer straight, but curved. From a study of such tracks it is possible to obtain information as to the loss of energy and the change of the charge of a single atom moving through matter. The difficulty of this experiment is the necessity of using a very strong magnetic field. The author has recently published a description of a method of producing strong magnetic fields for a small fraction of a second [see Abstract 2215 (1923)]. The strength of this field is of the order required for this kind of experiment, and the short period of time (0·01 sec.) during which the field is available is still very long compared with the time (10^{-7} sec.) taken for the α-particle to describe its trajectory. A preliminary account of this work has already been published [Abstract 2595 (1924)]. In the present paper details are given of the experimental apparatus and procedure and the analysis of the tracks and the deductions made from the analysis. Excellent photographs of curved α-ray tracks are reproduced in illustration. Tracks of this nature were obtained in air and hydrogen and the curvature measured at points along the course of the track. The mean value of e/v of the α-particles for different parts of the range from 1 to 20 mm. is given, and the velocity curve of α-particles at the end of their range is deduced. A. B. W.

376. *Range of α-Particles in Rare Gases.* **L. F. Bates.** (Roy. Soc., Proc. 106. pp. 622–632, Nov. 1, 1924.)—In a recent paper R. H. Fowler [Abstract 2446 (1923)] has calculated the atomic stopping powers of various substances for α-rays on the basis of Henderson's theory of the loss of energy of an α-ray in passing through matter [Abstract 190 (1923)], and has drawn attention to the desirability of a systematic investigation of the range of α-rays in different media. In particular, the considerable discrepancy between experiment and theory in the case of helium made it desirable to carry out further measurements with this gas for the purpose of confirmation. The author has carried out such measurements and has extended the work to the other rare gases. The results obtained are as follows:

Gas.	He.	Ne.	A.	Kr.	Xe.
Stopping power	0·1757	0·586	0·930	1·330	1·804

These results indicate that the Henderson theory, whilst accounting for a large proportion of the energy loss suffered by an α-particle in passing through matter, does not account for all of it, but only about 75 % in each of the above gases. The simple Bragg and Kleeman law of stopping power is shown to be approximate only. A. B. W.

377. *The β-Ray Spectrum of ThB + C.* **W. Pohlmeyer.** (Zeits. f. Physik, 28. 3–4. pp. 216–230, 1924.)—The β-ray spectrum of ThB + C is investigated by ionisation measurements in a magnetic field. Close to the two strongest lines of ThB at $H\rho = 1385$ and 1750 were also the stronger lines of ThC + C″ at 1584, 2610, and 2896. Moreover, between 1456 and 1973 the influence of several weaker lines of ThB and ThC + C″ is made clearly perceptible. The limits found for the spectrum on the side of quickest rays are in accord with those found by v. Baeyer, Hahn and Meitner. The intensity of both the strongest ThB lines is great in relation to the continuous background. It is shown by the experiments and the discussion of the results that the continuous background is traceable to secondary influence. A. E. G.

378. *β-Ray Spectrum of Mesothorium* 2. **D. H. Black.** (Roy. Soc., Proc. 106. pp. 632–640, Nov. 1, 1924.)—A more detailed analysis of this spectrum than has hitherto been obtained is now described, an accurate focussing method being used. The results support the theory that the electrons are emitted from the various energy levels in the atom by nuclear γ-rays. The theory that the γ-rays arise through energy transitions in the nucleus is also supported. **A. B. W.**

379. *The Absorption and Scattering of γ-Rays of Very Great Energy in the Light Elements.* **J. Thibaud.** (Comptes Rendus, 179. pp. 815–818, Oct. 27, 1924.)—The recent work of Ellis [Abstract 144 (1925) has led to the conclusion that the β-rays of RaC are a secondary effect of a certain number of γ-rays, but the attempts to find definite evidence of the transformations of these rays by photoelectric effects into an "excited spectrum" are unsound. It was concluded that a very feeble absorption of these ultra-penetrating radiations takes place, but the author has shown that it is possible to obtain excited β-ray spectra similar to the natural ones of RaC, and that the energy of the emitted corpuscle can be altered by changing the nature of the radiating substance, these radiations being again absorbed in the extra-nuclear levels of the atoms. The law expressing the absorption of X-rays—*i.e.* $\tau A/\rho = CN^4\lambda^3$—leads to the conclusion that the probability of the emission of an electron is proportional to the square of the energy of extraction and the fourth power of the atomic number. The author has investigated the absorption of γ-rays and found that a ray is more absorbed in an electronic layer when the energy of the latter is considerable. It is concluded that, contrary to the N^4 law, it is possible to excite photoelectrons of comparable intensity from light elements such as Ce, Sb, Sn, Ag, Se, Cu, and Fe. It is remarkable that rays having energies of 6×10^5 to 1×10^6 volts have an effect on levels having energies of 7 to 8×10^4 volts. The absorption of the γ-rays decreases less rapidly with N than is indicated by an extrapolation of Bragg's law. The λ^3 law appears to hold. The Compton-effect has been sought for γ-rays, where it should be particularly marked, but the effect appears to be of the same order as for X-rays. It is suggested that the degradation of the quantum may explain the continuous background observed in β-ray spectra. **W. V. M.**

380. *Penetration Radiation at High Altitudes.* **A. Wigand.** (Phys. Zeits. 25. pp. 445–463, Sept. 15, 1924.)—There is present in the atmosphere a radiation of such great power of penetration that the electromagnetic spectrum must be extended beyond the hardest γ-rays of the known radio-active substances in order to place it. In the present paper, which is a *résumé* of the work on the subject, the experimental researches are referred to, as are also hypotheses of the origin and action of the rays. The penetrating γ-rays of the soil and lower layers of the air are only incidentally mentioned. In the historical section the following points are dealt with: (*a*) Observations in the free atmosphere; (*b*) observations in the soil. The methods of measuring the radiation is dealt with at some length and then the properties as follows: (*a*) alteration with the altitude; (*b*) ground value; (*c*) absorption coefficient; (*d*) direction; (*e*) temporary deviations. The connection with the earth field problem is also discussed. A useful synopsis of the literature on the subject is given. **A. E. G.**

HEAT.

381. *The German Legal Temperature Scale and Heat Unit.* **M. Jakob.** (Zeits. Vereines deutsch. Ing. 68. pp. 1176–1178, Nov. 8, 1924. From the Reichsanstalt.)—Though the units of length, area, volume and weight were legalised in Germany in 1868 and the electrical units in 1898, the scale of temperature and the unit of heat were not defined by law until August 1924. The author outlines the vigorous efforts which have been made to this end during the past twenty-five years, and points out the difficulties arising from the use of the Réaumur scale. The scale of temperature decreed by the new law is the thermodynamic scale, subject to the provision that the normal melting-point of ice be denoted by 0° and the normal boiling-point of water by 100°. The thermodynamic scale, independent of the working material and defined solely by a cycle of working, has the great advantage that it is applicable even at the highest temperatures where gas thermometry fails; it is therefore applicable also to radiation measurements. The legal unit of heat is the "kilocalorie," *i.e.* the quantity of heat which is required to raise 1 kg. of water at atmospheric pressure from 14·5° to 15·5°. The kilowatt-hour is stated to be equal to 860 kilocalories. The stated scale of temperature and unit of heat are made compulsory for all commercial transactions. The permissible limits of error are to be prescribed by the Reichsanstalt, and the use of instruments with greater error is forbidden. Other clauses in the law make provision for testing, and state penalties for infraction of the decree. The article concludes with notes on the practical bases of the legal scale of temperature. R. E. N.

382. *Specific Heat of Bromine at Low Temperatures and its Chemical Constant.* **R. Suhrmann and K. v. Lüde.** (Zeits. f. Physik, 29. 1. pp. 71–77, 1924.)—Measurements of specific heat down to 20°·5 abs. From these the chemical constant is $+ 2 \cdot 546 \pm 0 \cdot 10$. A. D.

383. *Dependence of the Coefficients of Expansion of Liquids on their Temperature and Chemical Structure.* **J. J. Saslawsky.** (Zeits. phys. Chem. 113. pp. 111–130, Oct. 18, 1924.)—The equation previously given for the relationship between the density and temperature of liquids [Abstract 2384 (1924)] leads to the following expression for the coefficient of expansion: $\beta = \dfrac{1 \cdot 363}{\sqrt{T_0 T} + 2 \cdot 73T}$. The experimental data for a number of liquids at − 90°, − 30°, 20°, 40°, 100°, 140°, and 200°, correspond for most liquids very closely with the values of β given by this expression. Only with certain groups of compounds, such as the alcohols, is there consistent and marked disparity between the observed and calculated values of β. It can then scarcely be claimed that the coefficient of expansion represents an individual property of any given liquid. For most liquids β is a simple function of the critical and observation temperatures, so that, as a characteristic of the liquid, it is more suitable to consider, not the absolute magnitude of its coefficient of expansion at the given temperature, but the nature and the magnitude of the deviation of its thermal expansion from the normal course. In the comparison of a series of normally expanding liquids at any constant temperature, a higher value of β corresponds with a lower critical temperature. On the other hand, every ideal liquid with normal expansion has at the absolute zero of temperature a minimum value of β, namely, $\frac{1\cdot 365}{3\cdot 73T_0}$, and at the critical temperature a maximum value, β then approaching an infinite value as the liquid changes to vapour. The deviations from the above regularity of the expansion in the case of certain groups of substances is scarcely explainable by the association of the liquid molecules. T. H. P.

384. *The Evaporation of Small Drops of Water.* **N. Gudris** and **L. Kulikowa.** (Zeits. f. Physik, 25. 2. pp. 121–132, 1924.)—The vapour pressure p_k on a convex surface is higher than that p_0 of saturated vapour on a flat surface of the same liquid. A drop of the liquid surrounded by saturated vapour therefore tends to evaporate. Calculations based on the theory of diffusion indicate that drops of water and mercury of radius about 10^{-4} to 10^{-5} cm. should be completely evaporated within a few seconds. Schidloff, Karpowicz, McKeehan, and Targonsky have found, however, that the radius of a drop decreases only by 10 to 30 % during a period of several hours; also the rate of evaporation decreases, whereas the pressure difference $p_k - p_0$ increases. The authors' investigation of the evaporation of drops of water in various gases shows that the rate of evaporation depends largely upon the absorption of the gas by the drops. This explains the observed progressive retardation of evaporation and the influence of the "age" of the drop. Observations of evaporation under different vapour pressures show that the rate of vaporisation of the drop does increase with the pressure difference $p_k - p_0$. Also, by reducing the vapour pressure on the drops, it is possible to delay their evaporation; and if the reduction is such that the vapour pressure on the drops is less than that on a flat surface, the drops increase in size instead of evaporating. The experimentally determined pressure on the drops in the state of equilibrium agrees with that calculated by Kelvin's law. The authors' observations show that the evaporation of drops of the size stated is, within the limits of accuracy of the experiment, affected neither by the magnitude nor the sign of their electrical charge. R. E. N.

385. *Vaporisation of Liquid Mixtures.* **J. F. King** and **S. P. Smedley.** (J. Phys. Chem. 28. pp. 1265–1272, Nov., 1924.)—Three simple and rapid methods are described for determining the composition of a mixture of two liquids evaporating at constant composition: (1) A modification of the submerged bulblet method [Abstract 1279 (1910)] which is capable of yielding very accurate results. (2) By means of the Abbé refractometer the usual refractive index-composition curve is constructed. The prism is then opened and a definite amount of one of the mixtures is placed inside and allowed to evaporate for a definite number of seconds, the prism being then closed and the refractive index of the residue determined. Repetition of this with other mixtures gives a curve, which cuts the other curve at a position corresponding with the mixture which does not change in composition on evaporation. (3) The air-bubbling method, in which a certain volume of air at definite temperature and pressure is passed through mixtures of the liquids and the resulting changes in composition determined. The vapour pressure curve for mixtures of carbon tetrachloride and alcohol at 20° and the densities of the mixtures at 20°/4° are given. T. H. P.

386. *The Vapour Pressures of Rochelle Salt, the Hydrates of Sodium and Potassium Tartrates, and their Saturated Solutions.* **H. H. Lowry** and **S. O. Morgan.** (Am. Chem. Soc., J. 46. pp. 2192–2196, Oct., 1924.)—The method employed was the "static" method with mercury as the enclosing liquid in a "tensimeter" bulb of volume 30 cc., of which one-half to two-thirds was filled with vapour. The observation of van Leeuwen that Rochelle salt which had previously been heated above 40° C. could not be made to give reproducible values of vapour pressure was confirmed. When the salt was heated above 40° C., the vapour pressure when subsequently at 20° C. reached an apparently constant value which ranged from 12·6 mm. to 6·6 mm., depending on both the time which it held this temperature and the maximum temperature to which it had been raised. The correct value for Rochelle salt at 20° C. is 6·3 mm. The vapour pressure measurements on the saturated solution of Rochelle salt show that the solid phase in such a solution is unstable above 40° C. The fact that the points obtained with decreasing temperature in the transition range fall on a different curve from that obtained with increasing temperature in the same range indicates that equilibrium had not been reached. The vapour pressures of Rochelle salt and the hydrates of sodium tartrate and potassium tartrate were determined for several temperatures between 15° and 40°, and are incorporated in separate tables. S. G. B.

387. *The Preparation, Freezing-Point, and Vapour Pressure of Hydrogen Fluoride.* **J. Simons.** (Am. Chem. Soc., J. 46. pp. 2179–2183, Oct., 1924.)—The paper gives details of an apparatus for the distillation of hydrogen fluoride from anhydrous potassium acid fluoride. It consists of a heavy copper retort which is heated by a large blast ring burner so as to apply the heat near the surface of the molten charge. The lid and leading tube are tightly clamped with copper. The leading tube has a chamber tightly packed with copper wire to eliminate any salt spray that may be carried over. The acid is then condensed in a suitable receiver. The freezing-point was determined in a gold-plated cylindrical copper vessel fitted with a copper walled tube in which was inserted a thermocouple. The acid was frozen with liquid air and a time temperature curve taken as it warmed up slowly. The freezing-point was found to be − 83° C. The vapour pressure was also investigated in a specially designed apparatus made of copper, full details and diagram of which are given. It was found that it was possible to establish the vapour pressure curve from − 81° C. to + 47° C. and a pressure of 25 atmospheres. Tables of results are appended. S. G. B.

388. *The Density and Molecular Complexity of Gaseous Hydrogen Fluoride.* **J. Simons** and **J. H. Hildebrand.** (Am. Chem. Soc., J. 46. pp. 2183–2191, Oct., 1924.)—The "dynamic" method of measuring vapour density was adopted. Nitrogen freed from oxygen and dried thoroughly was bubbled through anhydrous liquid hydrofluoric acid. It was then passed through copper tubes containing dry sodium fluoride, which absorbed the hydrogen fluoride, the quantity of which was ascertained by weighing the tubes. Knowing the vapour pressure of the liquid and the weight of the acid carried off by a known quantity of nitrogen the density and apparent molecular weight of the gas were calculated from the perfect gas law. The vapour density of HF was thus determined at a series of temperatures below its boiling-point. The data obtained, together with that of Thorpe and Hambly for higher temperatures, have been closely examined by assuming that the vapour contains an equilibrium mixture of HF and $(HF)_6$ with a heat of association of 6670 calories per mole of HF. Full experimental details and tables of results are appended. S. G. B.

389. *Thermostats for Very High Temperatures.* **L. H. Adams.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 599–603, Nov., 1924.)—A method is described for the automatic regulation of high temperatures. The principle of the apparatus is that the heating coil of the furnace forms one arm of a Wheatstone bridge. A change in temperature of the furnace upsets the balance of the bridge, which applies an E.M.F. to the galvanometer and operates a mechanism which increases or decreases the current through the furnace. Thus a large amount of energy is available for the adjusting galvanometer, and for a platinum resistance furnace connected to a 110-volt supply the change in galvanometer E.M.F. for 1° was several millivolts. The main line contact opens and closes once or twice per second and the thermal lag between heating coil and furnace interior is such that furnace temperature fluctuations are negligible. The essential parts of the apparatus are a Wheatstone bridge consisting of a furnace coil, three fixed resistances with two variable resistances. The unbalanced e.m.f. is applied to a galvanometer which works in conjunction with a thermionic valve and two relays which so regulate the heating current that a constant furnace temperature is maintained. A full diagram is given. With this regulator a platinum-wound furnace at 1400° C. will be constant within 0·1° for hours at a time. The chief advantages of the method are its ease and certainty of operation, no part of the mechanism is inside the furnace cavity, high sensitivity and negligible lag between heater and regulator. S. G. B.

390. *A Substitute for Liquid Air in Low-Pressure Work.* **F. E. Poindexter.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 629–634, Nov., 1924.)—In using mercury diffusion pumps to produce low gas-pressures a trap is essential between the pump and the vessel which is to be evacuated, and the absence of such a trap makes the lowest pressure attainable the vapour pressure of mercury-vapour at the prevailing room-temperature. Usually a glass tube immersed in liquid air is used as trap. The paper describes a method by which a tube containing sodium is used as trap, and the pressure so attained is as low as that obtained with liquid air. The sodium is not immersed in liquid air, the use of which is dispensed with. A detailed description of the apparatus used and the design of special sodium tube is given as well as experimental results. Cadmium was also found to work well in the trap as well as zinc and gold, but the latter to a much less degree of efficiency. In experimental work it was found that the lowest pressure attained was after thirteen days, and even after one hundred days the pressure was only augmented by a 8×10^{-7} mm. of mercury-vapour pressure passing the trap, using a sodium tube. S. G. B.

391. *Application of the Pyrometric Method to the Investigation of Equilibria at High Pressures.* **N. A. Puschin and J. V. Grebenschtschikow.** (Zeits. phys. Chem. 113. pp. 57–78, Oct. 18, 1924.)—Experiments with diphenylamine, urethane, phenol and other substances show that, though requiring a somewhat more complicated apparatus, the pyrometric method is in some respects preferable to the manometric. There is a great saving of time. From half to three-quarters of an hour is sufficient for an investigation, in the course of which the temperatures of crystallisation at various pressures can be measured. A much smaller quantity of the substance suffices: 1 to 2 g. as against 40 g. generally used by Tammann with the manometric method. It is also possible to estimate variations of temperature of crystallisation with pressure. This is of special importance, because the temperature of crystallisation—an important factor in the fundamental equation of Clausius-Clapeyron, $dT/dp = T\Delta v/q$—is very difficult to determine experimentally at high pressures. But the great advantage of this method is that it can be employed for the investigation of equilibria in systems consisting of more than one component, as was shown by examples in a previous paper (Russ. phys.-chem. Ges., J. 44. 244, 1912). E. F.

392. *The Activity Constants of Dilute Aqueous Solutions of Hydrogen Chloride, Thallous Chloride and Lead Nitrate.* **M. Randall and A. P. Vanselow.** (Am. Chem. Soc., J. 46. pp. 2418–2437, Nov., 1924.)—The activity coefficient can be determined by the e.m.f. method, the solubility method, and the freezing-point method. The authors have used the first and third methods, and describe a new form of freezing-point apparatus, in which two Dewar flasks were used, enclosed in two brass cylinders, which could be evacuated so that all dissolved air was removed. In making a measurement one of the flasks was filled with a mixture of ice and conductivity water, and the other with ice and a solution of the salt in conductivity water. One of the two junctions of the thermo-element was placed in a glass tube in each of the Dewar flasks, which were provided with stirring mechanisms worked by an electric motor. An attempt was made to measure the conductivity of the solution, simultaneously with the measurement of the lowering of the freezing-point, by enclosing conductivity cells in the Dewar flasks, consisting of glass tubes open at both ends and provided with electrodes; the lower ends had fine mesh cotton-netting tied over them to keep out the ice. The arrangement did not prove satisfactory, and the "molality," in moles per 100 gr. of water, was determined by drawing off some of the solution and measuring its conductivity in an ordinary conductivity cell. The activity coefficients, calculated from the measurements with HCl, show satisfactory agreement with those calculated from the e.m.f. measurements; those calculated from the lowering of the freezing-point of thallous chloride show satisfactory agreement with those calculated from solubility measurements. The values of the activity coefficient for the three salts investigated do not agree with the theoretical equation of Debye and Hückel, or with Brônsted and la Mer's modification of that equation. H. N. A.

393. *Helium Gas and its Uses.* **J. C. McLennan.** (British Science Guild Publ. Service, Pamphlet No. 1. Brit. J. of Radiology, 20. pp. 171–173, Oct., 1924.)—Helium gas is extracted from the natural gas in the United States to the extent of 30,000 to 40,000 cub. ft. per day. Owning to its non-inflammable and non-explosive properties, it can be used for filling airship envelopes. Helium possesses 92 % of the lifting power of hydrogen, and this can be increased by mixing helium with 15 % of hydrogen, the mixture remaining non-explosive and non-inflammable in air. Further uses of helium are the filling of thermionic valves for use in wireless and for filling incandescent filament lamps and arc lamps. The nearest approach to absolute zero of temperature was obtained by liquefying helium at a temperature of 490° F. below the freezing-point of water. At this temperature a number of metals were found to possess a "super-conductivity." Examination of the resources of helium supplies in the British Empire shows that from 10 to 12 million cub. ft. of helium could be obtained annually from natural gases in Canada. **F. J. B.**

394. *Measurement of the Heating Value of Gas.* **C. V. Boys.** (Roy. Inst., Proc. Advance Proof. Received Aug., 1924.)—Describes the salient features of the Boys' Recording Calorimeter. [See Gas Journal for June 28 and July 5, 1922, also Abstracts 1604 (1923) and 567 (1924).] The details of the instruments can only be understood by the aid of the nine illustrations accompanying the text. In a note the author describes his method for the autogenous soldering of lead when the lead sheet is very thin. A cool flame is used which will barely melt lead at all, but which ensures a reducing atmosphere at the point of operation. The welding is effected by intense local heat formed by a tiny arc between a pointed carbon as negative pole and the lead as positive pole. The flame is fed with mixed hydrogen and carbon dioxide supplied by two large Kipp generators. **E. G.**

395. *A New Method of Micro-Gas Analysis.* **L. Reeve.** (Chem. Soc., J. 125. pp. 1946–1954, Sept., 1924.)—Instead of measuring considerable volumes of gas under reduced pressure, the simpler process was adopted of measuring the gas at atmospheric pressure in a calibrated capillary tube. **T. M. L.**

396. *A Study of Pfund's Pressure Gauge.* **R. T. Cox.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 569–582, Nov., 1924.)—Pfund's combination of the McLeod and Pirani pressure gauges was studied with a number of gases. The calibration curves of pressure against galvanometer reading were found to be straight lines and, except for hydrogen, nearly interchangeable for all the gases used. By using a galvanometer of high sensitivity and introducing a compensating filament, the sensitivity of the gauge was increased until a change in pressure of $1 \cdot 5 \times 10^{-9}$ mm. of mercury would cause a change in deflection of 1 cm. on the galvanometer scale. Brief comments are made on the release of carbon monoxide and air from cocoanut charcoal and on the adsorption of air at low pressure by silica gel. **AUTHOR.**

SOUND.

397. *Application of a Thermionic Valve to the Measurement of the Damping of a Steel Wire.* **Florence M. Chambers.** (Phil. Mag. 48. pp. 636–645, Oct., 1924.)—This paper gives results of experiments on the damping of the forced vibrations of a steel piano wire, the object being to obtain numerical values for the coefficient of damping in the equation of motion and to examine its variation with pitch and with the method of supporting the wire. The method adopted is to mount the wire upon a suitable sonometer, so that it lies between the flat poles of an electromagnet, and to set it into forced oscillation by connecting it in series with the condenser of a valve-maintained oscillatory circuit. The amplitude of oscillation of the string is observed at a number of frequencies by means of a reading microscope. Observations of the vibration form of the string by the method of Krigar Menzel and Raps showed that the forced motion was very closely simple harmonic. Three sonometers were used, two of wood (the base of one was cracked), the third consisting of an iron lathe bed. Tests were made with the string horizontal and also vertical; great difficulty was experienced in the former case in keeping the amplitude constant, due to slight changes in tension. It is found, as would be expected, that the damping with the cracked sonometer is greater than for the uncracked one. The damping coefficient with wooden sonometers increases with pitch; with a vertical string over one bridge the damping is less than when the string is supported horizontally on two bridges. The damping of a vertical string, supported on a lathe bed and kept in tension by a hanging weight, is very small and very much influenced by the end conditions, especially the way in which the weights are attached to the string. With a single heavy weight symmetrically fixed to the end of the string it is found that damping decreases with rise of pitch. B. H.

398. *The Explosion at La Courtine.* **P. Villard.** (Comptes Rendus, 179. pp. 617–620, Oct. 6, 1924.)—The explosion at La Courtine was heard at distances greater than 300 km., at Fontainebleau, for example, but only very faintly. Deslandres at Meudon and Dufour at Paris [see Abstracts 2300 and 2301 (1924)], however, obtained records of aerial waves of large amplitude, but these waves were of very low frequency. Dufour's record indicates a sinusoidal movement lasting about three seconds, the period being nearly one second. The record shows no trace of vibrations of audible frequency which would constitute the noise of the explosion. The author remarks on this observation, which he considers general: "The pressure wave produced by the detonation of a large quantity of explosive is generally found to be of low frequency, however violent and however near to the charge the observation is made. The noise constitutes an accessory phenomenon of practically negligible importance." Reference is made to the author's experiences of a large explosion at 1800 metres. At the moment of arrival of the noise a puff of air was felt on the observer's face, suggesting that by far the greater part of the mechanical energy in the air-wave was of very low frequency. A similar experience is described when at a distance of 7 km. from another large explosion. Observations of a similar character but with much smaller charges (*e.g.* a large gun and a pistol) lead the author to suppose that in the sound spectrum of an explosion the wave-length corresponding to maximum energy increases with the weight of explosive used. These observations are of considerable importance in relation to the study of zones of silence. A. B. W.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY

399. *On the Magnetic Field of the Moving Electron.* **F. Guéry.** (Comptes Rendus, 179. pp. 895–897, Nov. 3, 1924.)—The paper contains a discussion of the work of various investigators, commencing (I) with Maxwell's generalisation of Ampère's law of action between two current elements, and Poincaré's observations thereto. Section II discusses Laplace's law of the action of a magnetic pole upon a current element applicable to the case of an infinite rectilinear current. In section III the laws of Maxwell and Laplace are contrasted, and the reasons given for the rejection of the latter. Section IV discusses the current from the Lorentz viewpoint as a circulation of electrons endowed with an electric and a magnetic field. The conclusion is drawn that the magnetic field of the electron is only a mathematical expression without physical reality. H. H. Ho.

400. *The Comparison of Capacities by Means of a Triode.* **K. Gorbatscheff.** (Phys. Zeits. 25. pp. 485–487, Oct. 1, 1924.)—Describes an experimental arrangement of triode circuits to compare capacities varying from 0·001 to 10 m.f. The arrangement is illustrated and curves and tables of comparative measurements given. B. J. L.

401. *Atmospheric Electricity.* **A. Gockel.** (Phys. Zeits. 25. pp. 381–390, Aug. 1, 1924.)—Much material from scattered sources bearing upon atmospheric potential-gradient and conductivity is tabulated. Daily and annual changes of the properties are discussed. Contradictions in interpretation will arise so long as the causes of conductivity changes are sought in the direct action of sunlight rather than indirectly through changes in atmospheric pressure. Some relation between electrical state and barometric pressure does exist. The great influence exerted on the electrical properties of the atmosphere by the humidity renders any direct operation of sunlight on ionisation improbable. The desired connection can be found in the vertical streaming of the atmosphere, which carries up the disintegration products of radio-active emanations. W. A. R.

402. *Preliminary Report on the Atmospheric Potential-Gradient recorded at the Apia Observatory, Western Samoa, May, 1922, to April, 1924.* **A. Thomson.** (Terrest. Magn. 29. pp. 97–100, Sept., 1924.)—The paper gives preliminary summaries of the atmospheric potential-gradient data from continuous records obtained, under the auspices of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, at the Apia Observatory for two years during May, 1922, to April, 1924. The diurnal variation in the potential-gradient is determined from those days on which no negative potential occurred and its outstanding features are the maxima at about 8 a.m. and 7 p.m., local mean time. AUTHOR.

DISCHARGE AND OSCILLATIONS.

403. *Activisation of Chlorine by Electric Discharges.* **K. Schaum** and **A. Feller.** (Zeits. wiss. Phot. 23. pp. 66–71, Sept., 1924.)—The results of the present experiments show that by means of electric discharges a relatively slow decaying activisation of chlorine occurs which, with a current velocity of 3 litres per hour in a conducting tube of 2 cm. diameter, at a distance of 20 cm. from the place where activisation takes place, still shows over a sixth part of the original value. The activisation is so much the stronger the higher the primary tension. Whether the activisation products are ions of chlorine or Cl_3 it is not possible to decide at present. A. E. G.

404. *On Some Properties of Low-Tension Discharge Tubes.* **J. Taylor.** (Experimental Wireless, 2. pp. 41–47, Oct., 1924.)

405. *Damping of Oscillations of a Hertzian Resonator.* **W. P. Allis.** (Comptes Rendus, 179. pp. 677–679, Oct. 13, 1924.)—The damping of a resonator excited by continuous waves is here dealt with. The resonance curve is traced by employing, as was done by Bjerknes in the case of damped waves, an electrometric method. The experiments are, however, not carried out with a circular Hertz resonator, but with a resonator of the class used by Blondlot, and of such capacity that Thompson's formula may be applicable to it. The decrement of the free oscillations of the resonator obtained from the resonance curve is the sum of two terms δ_J corresponding to the Joule effect, δ_H to radiation. The first having been calculated starting from the ohmic resistance, the other is obtained by difference. The product $\lambda^2\delta_H$ varies little, and its variations are of the order of possible experimental errors, and it is therefore concluded ~~that~~ δ_H is inversely proportional to the square of the wave-length. A. E. G.

406. *On the Output of Radiation from the Quartz-Mercury Arc during the Period after First Striking.* **B. D. Watters.** (Brit. J. of Radiology, 20. pp. 163–169; Disc., 169–170, Oct., 1924.)—Gives the results of tintometer measurements of intensity of ultra-violet radiation from the quartz-mercury arc. Simultaneously readings of current and voltage were taken. The noticeable feature is, on striking the arc, a very intense radiation which rapidly falls off during the first and second minutes and then slowly rises again, without reaching the value of the first intensity. The voltage rises and current falls during the attainment of the final steady value. By means of a special tintometric arrangement which is illustrated the intensity at different portions of the arc was measured and was found to be a maximum in the central portion of the tube. The subject is discussed from the spectrographic aspects. No explanation is offered of the phenomena which formed the subject of subsequent discussion. B. J. L.

407. *Ionising Potentials of Multiatomic Gases.* **C. A. Mackay.** (Phys. Rev. 24. pp. 319–329, Oct., 1924.)—Ionising potentials for helium and fifteen compound inorganic gases were measured by accelerating photo-electrons through a gauze into a chamber where the positive ions produced were drawn to a fine Pt electrode, made small so as to eliminate effects due to radiation. The current-voltage curves obtained consist of straight lines except at the breaks. Corrections for initial velocity, etc., were made by obtaining on the same curve both a break for the unknown gas and one for mercury (10·4 volts). The values found are, in volts: helium, 24·5; hydrogen, 15·8; nitrogen, 16·3; oxygen, 12·5, 16·1;

HCl, 13·8 ; HBr, 13·2 ; HI, 12·8 ; water, 13·2 ; NH_3, 11·1 ; Cl_2, 13·2 ; Br_2, 12·8 ; I_2, 10·0 ; NO, 9·4 ; CO_2, 14·3 ; CO, 14·1, 15·6 ; H_2S, 10·4. Comparison is made with results of other observers. Theoretical Interpretation.—An attempt is made to test the thermochemical method of estimating ionising potentials in those cases (H_2S, NH_3, H_2O) where data are available. No process of ionisation involving molecular dissociation seems consistent with the experimental results. This and other evidence suggests that in those cases (HCl, HBr, HI) in which the thermochemical calculations yield accurate results, the agreement may be fortuitous, and that the lowest ionization potentials in each case corresponds to ionization without dissociation. [See Abstract 934 (1924).] AUTHOR.

408. *Influence of Gaseous Diffusion on Almost Saturated Currents.* **G. Jaffé.** (Ann. d. Physik, 75. 4. pp. 391–402, Oct., 1924.)—A mathematical paper, in which consideration of the diffusion and reunion of ions in gases is applied to the development of the current-potential characteristics for almost saturated currents, that is, those proceeding according to falling powers of the potential difference. Older results for the plate condenser are rendered more exact, and fresh calculations for cylindrical and spherical condensers made. Characteristics are derived which hold for any potential difference, provided that the distance between the electrodes is sufficiently small. T. H. P.

409. *Modification of Laws of Emission of Ions from Hot Metals by the Quantum Theory.* **S. C. Roy.** (Indian Assoc. for Cultivation of Science, Proc. 9. 1. pp. 61–81, 1924.)—Although the classical electron theories of metals, developed by Drude, Lorentz, Thomson and others, have given a fair account of the various outstanding physical properties of metals, such as the heat and electrical conductivity, the Peltier-effect, the Thomson-effect, the Richardson-effect and so on, the various secondary hypotheses which have been advanced to explain these phenomena are seldom convincing and are often in contradiction with one another. The most obvious difficulty, however, is the question of the heat-capacity of metals. If the "free" conduction electrons could claim their full share in the equal distribution of kinetic energy, then this share of energy should be plainly noticeable in the atomic heats of these bodies. Such an increase in the atomic heats of metals as compared to metalloids which contain vanishingly few free electrons, has never been discovered. Further, as Lorentz has pointed out, the classical electron theory invariably leads to Rayleigh's law of radiation. In recent years the ideas have been developing that the law of equipartition of energy for the metallic electrons has got to be abandoned in favour of Planck's quantum law. The difficulty, however, lies in properly quantizing the motions of the metallic electrons and in explaining the thermal conductivity of metals and the correctness of Wiedemann-Franz's law on such a quantized theory. Lindemann has pointed out that the expression "free" electron, suggesting or intending to suggest an electron normally not under the action of any force is really a contradiction of terms. It is, therefore, conceivable that metallic electrons instead of forming an ideal gas, really constitute a condensed solid. In continuation of the conceptions of Born and Karman, it may be assumed that a metal crystal is constituted of interlocked space lattices of electrons, atoms or atomic residues. Lindemann has drawn up a theory of metallic state on the basis of these ideas. J. J. Thomson has, recently, developed similar ideas in his electron theory of solids. The object of the present paper is to consider statistically the laws of emission of ions or electrons from hot metals on the basis of the supposition that the metallic ions or electrons behave in all manner like Planck's line vibrators while the emitted ones constitute an ideal monatomic gas. It is concluded that it would be premature to pronounce any definite opinion on the question of identity between photoelectric and thermionic work functions, specially in view of the uncertainties in the determinations of the long wave-length limits. The data given here points to a general correspondence between the two, and also to make it abundantly clear that the work-function ϕ — is a function of the atomic volume. [See also Abstract 1879 (1924).] A. E. G.

410. *Doppler-Effect on the Canal Rays of Hydrogen.* **H. Krefft.** (Ann. d. Physik, 75. 5. pp. 513–520, Oct., 1924.)—This paper forms a supplement to previous work of the author [see Abstracts 3032 and 3033 (1924)]. The following points are here considered; (1) The Doppler-effect in the pencil; (2) the effect of introducing oxygen and nitrogen to the hydrogen in the discharge space; and (3) the influence of the strength of the current. The results are shown in both graphical and tabular form. A. E. G.

411. *The Conditions for Statistical Equilibrium between Atoms, Electrons and Radiation.* **P. A. M. Dirac.** (Roy. Soc., Proc. 106. pp. 581–596, Nov. 1, 1924.)—Klein and Rosseland, considering non-radiative encounters, point out that for thermodynamic equilibrium, when atoms are transferred to higher stationary states by collisions with free electrons, the reverse process, by which an atom falls from a higher to a lower state, the whole of the surplus energy being given to a colliding electron, must occur often enough to balance the first process. Fowler has shown, however, that there may be cycles of inseparable processes, each of which does not balance individually, though the whole cycle forms a unit mechanism, which balances [Abstract 1257 (1924)]. It seems plausible, however, to suppose that, if after any encounter all the velocities are reversed, the whole process will repeat itself backwards; each encounter will be just as likely to occur as its converse, in which every velocity has changed sign; this converse is not the same as the above reverse process, in which the velocities before and after the encounter are the same as those after and before the original encounter; the converse and reverse encounters are so related that one can be obtained from the other by successive reflections in three mutually perpendicular mirrors, and so their frequencies of occurrence must be equal. It is possible to apply the principle to the general case of encounters between an arbitrary number of systems, for processes which may or may not involve radiation. The author first deduces the law of transformation of density-in-momentum per unit volume of an assembly of similar particles, moving in any manner; but such that the law of distribution of velocity is constant in space and time, and finds that this quantity is invariant under a Lorentz transformation; he then treats mathematically the equilibrium conditions for non-radioactive processes, and proceeds to processes involving the absorption of radiation, and to general radiative processes, he deduces the general law that any atomic process, with emission of one or more quanta of radiation, is stimulated by radiation of the same frequency as that of any of the emitted quanta, the ratio of the stimulated emission to the spontaneous emission being proportional to the intensity of the incident radiation divided by the cube of its frequency, independent of the nature of the process, the direction of the stimulated radiation being the same as that of the incident radiation. Formulæ for the degree of ionisation of a monatomic gas, in statistical equilibrium, are obtained. **H. N. A.**

412. *The Rectifying Action of Contact Detectors.* **I. Stranski.** (Zeits. phys. Chem. 113. pp. 131–144, Oct. 18, 1924.)—As the result of the present investigation it is concluded that the rectifying action of contact detectors can be traced to change in the detector substance which exhibits a pronounced direction effect. **A. E. G.**

413. *Theory of Amplifiers with Reaction.* **G. Filippini.** (Elettrotecnica, 11. pp. 914–922, Nov. 25, 1924.)—This paper is mainly of a mathematical nature, and deals with the subject under the following heads: (*a*) A general investigation of the effect of coupling; (*b*) calculation of the total value of the amplification; (*c*) the circle of the amplification; (*d*) theory of the thermionic amplifier with magnetic coupling. **A. E. G.**

414. *A System which Reacts Differently to Damped and Undamped Vibrations.* **J. Zenneck.** (Phys. Zeits. 25. p. 441, Sept. 15, 1924. Paper read before the Bavarian Akad. d. Wissenschaften, June, 1924.)—The natural frequency of a circuit, with a coil containing an iron core, depends on the amplitude of the current. If a damped primary system acts on a circuit in the amplitude alters with time, and the circuit will never be in resonance with the primary system during the whole duration of the vibrations. It is shown that the use of a circuit of this kind to stop undamped vibration is only possible when the magnetisation of the core is carried above the elbow of the curve, so that large currents are necessary. Iron-nickel amalgams may, however, be employed, which can be saturated by fields smaller than one gauss. It is thought that, by using such coils, the damped vibrations produced in the aerial by atmospherics may be prevented from influencing the telephone, while undamped vibrations can get through. **H. N. A.**

ELECTRICAL PROPERTIES AND INSTRUMENTS.

415. *The Conductivity of Marble.* **G. Stetter.** (Phys. Zeits. 25. pp. 441–443, Sept. 15, 1924.)—The possibility of using marble as the material for a high electric resistance has been studied, and it has been found that the conductivity of this substance varies very greatly with its humidity. Carbon dioxide affects the conductivity when the air is damp, since the soluble bicarbonate $Ca\,(HCO_3)_2$ is formed, the solution of which has high conductivity. The true specific resistance of dry marble, regarded as a crystalline form of $CaCO_3$, lies above $1 \cdot 1 \times 10^{15}\Omega$ and below $10^{16}\Omega$, say at about $5 \times 10^{15}\Omega$; eight days in air saturated with moisture brought it down to $1 \cdot 5 \times 10^{10}\Omega$, while after soaking in water the specific resistance was only about $10^{6}\Omega$. In the last case the pores were filled with moisture, while exposure of the dry material to moist air coated the walls of the pores with moisture. It is suggested that measurements of conductivity under different conditions may give information as to the structure of a stone, size of grains and of pores. **H. N. A.**

416. *Galvanic Conductivity and Hall-Effect of Thin Nickel Layers.* **A. Riede.** (Zeits. f. Physik, 28. 3-4. pp. 177-215, 1924.)—By making use of kathode scattering in streaming hydrogen it is possible to set up nickel layers of a given thickness with an accuracy of 1 $m\mu$. The law, that electrical conductivity is proportional to the cross section, holds for such layers of nickel up to the smallest thicknesses, the uncertainty in the thickness being at most 12 $m\mu$. The Hall-effect in such layers is proportional to the strength of the field in weak magnetic fields (less than 200 gauss), in strong fields it approximates to a limiting value. It is proportional to the primary current up to a current strength of nearly 10^5 amps. cm^{-2} with an accuracy of at least 2 %. In the neighbourhood of a saturation region of field strength the distortion of the potential lines increases with diminishing thickness down to 15 $m\mu$. The sign of the effect is negative. A. E. G.

417. *Magnetic and Electric Properties of Electrolytic Iron and its Alloys Melted in Vacuo and Rolled into Sheet.* **M. Fukuda.** (Inst. El. Eng. of Japan, J. No. 435. pp. 978-1007, Oct., 1924. In English.)—Yensen, of the University of Illinois and Gumlich, in 1920, have already determined the magnetic properties of round bars of electrolytic iron and its alloys melted *in vacuo* and found a large increase in permeability of the iron—about double. The present investigation is concerned with sheet iron produced from metal melted *in vacuo* and rolled. The increase in permeability was not so good as in bars, but it is claimed to be 20 % better than that of Stalloy. In the course of the work it is noted that sheets containing a high percentage of aluminium have little retentivity, and are thus highly suitable for transformers, etc. The ordinary ballistic ring method was used for the determination of the magnetic values, and in the case of A.C. experiments a synchronous commutator was added to the apparatus. The rings to be tested were stamped out from the sheet and tested in three ways: (1) Without annealing; (2) annealed *in vacuo* and cooled slowly; (3) annealed *in vacuo* and quenched. Tables of results embodying permeability, hysteresis loss, etc., are given for various alloys and electrolytic iron. A portion of the work includes the measurement of core losses with alternating current and the separation of hysteresis and eddy-current losses. Graphs are given of the various tables. S. G. B.

418. *An Electrometer Method for Measuring Dielectric Constants of Liquids.* **A. P. Carman.** (Phys. Rev. 24. pp. 396-399, Oct., 1924.)—Differential idiostatic electrometer for the measurement of dielectric constants of liquids. The suspended system includes two cylindrical quadrants C_1 and C_2 suspended so as partly to overlap two fixed cylindrical plates A and B coaxical with C_1 and C_2 and so placed and connected that the torque due to the condenser AC_1 is opposite to the condenser BC_2. To determine the dielectric constant of a liquid, one of the condensers is immersed in it and the other immersed in a liquid or gas of known constant, and the differences of potentials $V_A - V_1$ and $V_2 - V_B$ for zero deflection are read by the potentiometer method. The dielectric constants are then proportional to $(V_A - V_1)^2/(V_2 - V_B)^2 = R_1^2/R_2^2$. This method gave for the dielectric constant for distilled water at 25° C. with 60-cycle e.m.f. the value 78·07. AUTHOR.

419. *String Galvanometer Oscillograph with Automatic Photography.* **A. Trowbridge.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9.

pp. 557–568, Nov., 1924.)—This paper describes the adaptation of the Einthoven string galvanometer to recording purposes, and deals in detail with the source of light, the timing device (in this case a small induction motor controlled by a tuning-fork), the galvanometer itself, and the camera for recording both the time and the motion of the moving parts (generally two separate moving parts) of the galvanometer. The mechanical, electrical and optical systems are described and illustrated. Some specimen records are reproduced; these include the "make" and "break" of a current of 10^{-4} amps. through two strings in series; a time scale of 0·01 seconds is shown. A number of records of indicator diagrams of the pressure variations in a four-cycle internal-combustion engine running at various speeds up to 1248 r.p.m. are also given. These records show the rate of pressure change with time, *i.e.* $\frac{dp}{dt}$. Various conditions of throttle opening, mixture strength and ignition setting are illustrated. The records taken were 2 in. wide and about 3 ft. long; the movements of the beam of light are clearly shown, and in the indicator diagram records much detail is given. A. W. J.

420. *A Sensitive Magnetometer, Insensitive to Extraneous Disturbances.* **E. P. T. Tyndall.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 465–468, Oct., 1924.)—The simplest type of magnetometer utilises the horizontal component of the magnetic fields at the suspended needle as the controlling field. Fluctuations in its direction or magnitude cause errors. Provided the direction of the field is constant, errors due to variations in intensity of the controlling field are eliminated by the use of a null method in which the torque on the needle due to the specimen is balanced by a known torque due to a current in a system of coils. The present instrument gives a control to any desired extent by an artificially applied field of constant direction. The apparatus is adapted so that both poles of the test specimen are effective. The magnetometer needle is an approximately astatic pair of magnets carried in two stirrups on an aluminium rod suspended on a single suspension fibre. The rod carries a small mirror. The magnets are separated by a distance equal to that of the specimen under test, if the two pole arrangement is used. A permanent magnet or system of coils is placed in a suitable position to give the desired controlling field. Generally the Gaugain-Helmholtz system was used, wherein four coils were connected in series in such a manner that for a given current they all produced torque in the same sense on the suspended magnets and in the opposite sense to that of the two poles of the test specimen. By adjustment of current in the coils the indicator spot of light is brought back to zero and from a knowledge of the dimensions of the apparatus and specimen, and the strength of the coil currents the magnetic constants of the test sample can be calculated. The paper gives a diagram of the system and full theoretical treatment. The magnetometer has a great sensitivity and no liability to erratic disturbances. S. G. B.

ALTERNATING CURRENTS AND MAGNETISM.

421. *The Evaluation of the Degree of Magnetisation of Permanent Magnets.* **J. Würschmidt.** (Zeits. f. Physik, 29. 3–4. pp. 175–185, 1924.)—The object of the paper is the testing of various kinds of steel, for which purpose the quantities $L = B_rH_c$, and $G = (BH)_{max.}/8\pi$ are investigated, where B_r is the remanence and H_c the coercive force, B and H possessing the usual significance. The magnetisation curves of a great variety of permanent magnets investigated are found to exhibit remarkable symmetrical properties to a close degree of approximation, *e.g.* if $x = H$, and $y = H_cB/B_r$, then the x, y curve is symmetrical in x and y, and the fraction $x \times y$ attains its max. for $x = y$. It follows that B × H reaches its maximum where the B . H curve cuts the lines $y/x = B_r/H_c$. The magnetisation curves for the permanent magnets are found to be represented with sufficient approximation by ellipses, whose centres and axes are determined by B_r, H_c and the values of B and H for $(B \times H)_{max.}$ (B_0 and H_0). H. H. Ho.

422. *Application of the Thomson Ring for the Investigation of Magnetic Spectra.* **N. Nikitin.** (Zeits. f. Physik, 29. 5. pp. 288–293, 1924.)—The use of the Thomson ring is first discussed for investigating the magnetic permeability of iron. From measurements of the high-frequency resistance of coefficients of self-induction of the ring the apparent and true magnetic permeabilities of the iron wire μ_k and μ_n are determined. The μ_k and μ_n curves are found to be in agreement with the viscous-elastic theory of the magnetic spectra. Apparatus and measurement details are included with three diagrams. H. H. Ho.

423. *Magnetic Anomaly, Koursk.* **P. Lasareff.** (J. de Physique et le Radium, 5. pp. 180–190, June, 1924.)—A gravity and magnetic anomaly at Koursk, Central Russia, has been previously described and proved to be due to a body of magnetic iron ore [Abstract 1300 (1924)]. No new result is here given, but detailed accounts of the work, the method employed, and the resulting maps are now published. W. A. R.

424. *A Method for Mapping Magnetic Vector Fields.* **P. Kirkpatrick.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 617–621, Nov., 1924.)—A simple experimental method for the determination by a series of operations of the direction and magnitude of the magnetic field vector. The magnetic field is given in terms of the local field strength of the earth, and the final diagram shows the true lines of poles under test uninfluenced by the earth's field. A horizontal board is capable of rotation about a peg fixed to a table-top, which carries a compass needle and scale. A projecting rail parallel to the edge of the table carries a T-square, which lies across the movable board. Firstly the table is so placed that zero deflection of the needle is seen. The position of the board for which the needle lies along the horizontal component of the earth's field gives the direction of the field at the axis of the board of a magnet placed thereon. If the board be now rotated through 90°, the earth's and magnetic fields will be normal to each other, and the tangent of the angle of deflection gives the ratio of the field strengths. The procedure is as follows: (1) Place the table for zero deflection. (2) Put magnet at any point and rotate board until deflection is again zero; then the earth's field and that due to the magnet are coincident, and their common direction is at right angles to the edge of the table itself or along one edge of the T-square. (3) A set-square is placed against the edge of the T-square and the board rotated through 90° until the earth and magnet fields are at right angles. (4) The magnet is removed, and a line drawn through its position by means of T-square and set-square records the field direction. This is repeated for various points and the whole diagram plotted. Illustrations of mounting and actual results of experiment are given. S. G. B.

425. *The Magnetic Susceptibility of Helium, Neon, Argon and Nitrogen.* **L. G. Hector.** (Phys. Rev. 24. pp. 418–425, Oct., 1924.)—The apparatus described in a recent paper by Wills and Hector [Abstract 1936 (1924)] for the measurement of the magnetic susceptibilities of gases has been rebuilt so as to enable the temperature to be controlled to 0·02° and the sensitivity of the method increased. The gases used were all carefully purified, and spectroscopic examination showed no oxygen lines. The results obtained for the volume susceptibilities at 20° C. and 760 mm. pressure for helium, neon, argon and nitrogen are $-0·780$, $-2·77$, $-7·52$, and $-4·91$ respectively; all times 10^{-10}. They are probably accurate to within 2 %. These results are of the order of magnitude required by Pauli's modification of the Langevin theory of diamagnetism and also agree with values predicted by Joos from the electron arrangements. AUTHOR.

426. *Records of Earthquakes and of Principal Magnetic Storms at the Watheroo Magnetic Observatory, Western Australia, from January to March, 1924.* **G. R. Wait.** (Terrest. Magn. 29. p. 128, Sept., 1924.)

427. *Principal Magnetic Storms recorded at the Huancayo Magnetic Observatory, Peru, from April to June, 1924.* **W. C. Parkinson.** (Terrest. Magn. 29. pp. 127–128, Sept., 1924.)

428. *Values of the Magnetic Declination in 1924 at Principal Stations in the Union of the Soviet Socialist Republics.* **A. Pödder.** (Terrest. Magn. 29. pp. 105–108, Sept., 1924.)

429. *The Computation of Tabular Quantities.* **F. Neumann.** (Terrest. Magn. 29. pp. 115–119, Sept., 1924.)—A description is given of a machine for the computing of results of magnetic and geodotic surveys. The hourly values of declination and horizontal and vertical intensity are computed by adding the converted hourly magnetogram readings to constant base-line values and applying the necessary corrections for temperature, etc. The system includes the use of an addition table and special copy-holder in conjunction with an adding and tabulating machine, and is claimed to give high speed and accuracy. The details of construction and a diagram are given fully. After placing the frame of the apparatus at any desired base-line, the sum of this and any desired number up to 200 can be read off directly from the table. S. G. B.

RADIOGRAPHY AND ELECTRO-PHYSIOLOGY.

430. *The Influence of Radiology upon our Conceptions of Disease.* **T. Horder.** (Brit. J. of Radiology, 20. pp. 147–162, Oct., 1924. Fifth Mackenzie Davidson Memorial Lecture.)—It gives a general review of radiological science, but contains no new matter. Of chief interest is the recognition of the value of X-ray treatment in cases of carcinomata. Since the author is not a radiological specialist, but a physician in touch with radiological work, this recognition from an independent source is of value. B. J. L.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

431. *New Determination of the Constant N of Avogadro, based on its Definition.* **P. L. du Noüy.** (Phil. Mag. 48. pp. 664–672, Oct., 1924.)—Further measurements with solutions of pure sodium oleate [Abstract 2852 (1924)] reveal distinct minima for the surface tension at the dilutions 1 : 750,000, 1 : 1,220,000 and 1 : 1,390,000. Each of these minima corresponds with the formation of a monomolecular layer, the orientation of the molecules being different in each of the three cases. The above figures render it possible to calculate the area of each of the three dimensions of the molecule, and hence the volume it occupies when symmetrically packed with others. The value thus obtained for N is $6 \cdot 003 \times 10^{23}$, which agrees well with the number $6 \cdot 062 \times 10^{23}$, given by Millikan. Similarly concordant values are found for the value of the electron and for the mass of the hydrogen atom. That these results are reliable is shown by the fact that, for each of the three above concentrations, the product of the number of molecules present by the area occupied by one molecule coincides exactly with the total area of adsorption, this being made up of the free surface of the liquid, together with the surface of the glass. T. H. P.

432. *The Solubility of Benzoic Acid in Benzene and in Toluene.* **J. Chipman.** (Am. Chem. Soc., J. 46. pp. 2445–2448, Nov., 1924.)—The solubilities, expressed as mole fractions, are practically identical above 30°. The latent heats of solution of benzoic acid are, in calories per mole, near the melting-point, in benzene 4770, in toluene 4630; from 25° to 80°, in benzene 6900, in toluene 6760; and as an average for both systems over the entire range 6360. H. N. A.

433. *The Determination of the Size of Invisible Particles in Emulsoid Sols.* **H. R. Kruyt and H. J. C. Tendeloo.** (K. Akad. Amsterdam, Proc. 27. 5–6. pp. 377–381, 1924.)—Von Smoluchowski has given an equation for the relation between the viscosity of a sol η, and that of the dispersant η_0, in terms of the volume of the particles as a fraction of the total volume ϕ, the specific resistance of the sol, the dielectric constant, the radius of the particles r and the potential difference in the double layer of the particle ζ; cataphoretic determinations made on the sol give the value of this potential difference in terms of the potential difference applied at the electrodes, the distance between the electrodes and the cataphoretic velocity of the particles; the authors have modified the apparatus so that ζ can be determined with an accuracy of about 2 %. All the quantities in the original equation can be determined experimentally except ϕ and r; if now determinations are made with two different concentrations ϕ can be eliminated from the two equations obtained and r determined; it is assumed that ϕ and r do not vary with the charge of the sol, which is modified by the addition of electrolyte. Tables are given for sols of starch, which show that constant values for ϕ and r actually are obtained from experiments using different quantities of three different electrolytes, the value of r being about 7 $\mu\mu$, so that the diameter of the hydrated particles is about 14 $\mu\mu$. Such particles are invisible in the ultra-microscope, and only give rise to a diffuse Tyndall cone. Even when the hydration water is left out of account the particle is too big to be considered as a chemical molecule. It is shown that the volumes of the dry and the hydrated particles are to each other as 3 : 7, so that without the water the diameter of the particle would be 6 $\mu\mu$. H. N. A.

434. *The System Sodium Carbonate–Sodium Sulphate–Water.* **W. A. Caspari.** (Chem. Soc., J. 125. pp. 2381–2387, Nov., 1924.)—The joint solubilities of sodium carbonate and sodium sulphate in water were determined at 20°, 25°, 30°, 35°, 50°, and 75° C. The composition of the solutions and the solid phases was found by direct estimation. The cryohydric point of the joint salts was found to be $-2 \cdot 45°$, Na_2CO_3 5·21 %, Na_2SO_4 2·06 %. The boiling-points of the saturated solutions and the composition of these solutions, the transition-points of the hydrates, were also determined. F. J. B.

435. *Conductivity of Chlorides in Fused Antimony Chloride, and Ghosh's Theory.* **Z. Klemensiewicz.** (Zeits. phys. Chem. 113. pp. 28–34, Oct. 18, 1924.)—The author resuscitates and corrects his own measurements [Abstract 163 (1909)] and compares them with Ghosh's theory. Within a wide range of concentrations KCl, NH_4Cl, RbCl dissolved in $SbCl_3$ give conductivities corresponding to one-one-valued salts; TlCl also gives a linear relation between $\sqrt[3]{\eta}$ and $\log_e \mu$, but with a tendency to increased values. Higher valued salts are much less dissociated in $SbCl_3$ than Ghosh's theory demands. The temperature relations of the conductivity comply qualitatively with the theory; quantitative conclusions cannot be reached for want of knowledge as to the dielectric constants. A. D.

436. *$(\alpha + \gamma)$ Eutectic in Brass.* **W. Heike and K. Ledebur.** (Zeits. f. Metallkunde, 16. pp. 380–381, Oct., 1924.)—Proof of the existence of the eutectic was obtained by the addition of manganese to a mixture of copper and zinc. 85 parts of a copper and zinc alloy (55 % Cu, 45 % Zn) were melted with 15 parts of manganese. The resulting alloy melted at 816° C., and showed a further evolution of heat at 400° C. The microstructure was that of a true eutectic. The manganese has a favourable influence upon the decomposition of the β mixed crystals. F. J. B.

437. *Ageing Effect of Quenched Alloys.* **I. Igarasi.** (Tôhoku Univ., Sci. Reports, 12. pp. 333–345, July, 1924. In English. 79th Report from the Research Inst. for Iron, Steel and other Metals.)—The ageing of alloys is shown to be, not an unusual phenomenon, but one observable in alloys which possess a transformation or a eutectoid change and are quenched from a temperature above it, and also in alloys in which the solubility of one component in the other rapidly increases with rise of temperature. The investigation described was carried out to ascertain the ageing effect in several quenched alloys by means of a sensitive differential dilatometer. The alloys investigated were 0·9 carbon steel; aluminium-zinc alloys containing 25, 45 and 75 % zinc; aluminium-copper alloys containing 0·5, 2, 4, 7, 15 and 88 % of copper; aluminium-magnesium alloys containing 0·1, 0·5, 0·8 and 1 % magnesium and duralumin and other aluminium-copper-magnesium alloys. In the case of the steel, an initial expansion is followed by a contraction. The initial expansion decreases with increase of the quenching temperature, and this is explained by the fact that as the quenching becomes more severe, the change from austenite to martensite is more difficult in virtue of the increasing stability of austenite. In the aluminium zinc alloys quenched from various temperatures, ageing contraction is shown due to separation of constituents. In the copper-aluminium alloy containing 12 % Al, an expansion followed by a slight contraction is found, and in the other alloys examined, ageing contraction only. The aluminium-magnesium alloys show an ageing expansion, duralumin shows an expansion followed by a contraction. The aluminium-copper-magnesium alloys, containing 0·5 % magnesium, show a continual expansion if the copper is below 3 %, but if it exceeds 3·5 % diminution of the initial expansion always follows. C. O. B.

438. *Stellite and Similar Alloys. Part I.* **E. H. Schulz.** *Parts I and II.* (Zeits. f. Metallkunde, 16. pp. 335–343, Sept., and **G. W. Drescher**, pp. 382–387; Disc., 387–390, Oct., 1924.)—Part I deals with alloys of iron containing a very small percentage of that metal, commencing with those with marked magnetic properties; the so-called K.S. steel of Honda and Saito is investigated both from the magnetic and the mechanical points of view; a forged bar was very brittle, could be cut with a saw, but it was very difficult to turn it. The effect of quenching from different temperatures was investigated, the Brinell hardness and the microscopical structure being observed. Other new magnet steels are mentioned, including permalloy. Stellite is first mentioned in connection with alloys which resist chemical action. There are a number of different stellites, with varying proportions of cobalt, tungsten and chromium; with these may be mixed smaller amounts of molybdenum, manganese, iron and carbon; for cutting tools a suitable alloy contains the following percentages: Co 40 to 55; Cr 15 to 33; W 10 to 17; C up to 2 and sometimes more; Fe up to 5. Tungsten is sometimes partly replaced by molybdenum, and small amounts of vanadium have been found; impurities, manganese and silicon. Schulz has investigated the effect of increased iron, of carbon and of silicon. A new alloy has been found, to which the name akrit has been given, in which nickel is added to the above constituents (10 %); it is possible to use more iron, up to 10 %, with this alloy, which makes it rather cheaper than stellite; at the same time a better cutting tool can be made from it than from stellite for use with a number of materials, though for a few materials the difference is not great. Microphotographical investigations of both stellite and akrit were made, and reproductions of these are given; these seem to show that the cutting properties depend on the presence of sharp needles, probably of carbides, in the finely dendritic ground structure. The cutting tools are generally constructed by electrically welding small plates of akrit to bars of Siemens Martin steel; special welding machines have been designed for this purpose. The alloy can be cast into a number of suitably formed rods, and can be worked by grinding. Several other new tool steels were mentioned in the discussion. H. N. A.

439. *The Structure of Rolled Cubic Crystallising Metals.* **F. Wever.** (Zeits. f. Physik, 28. 2. pp. 69–90, 1924.)—The alteration produced in the structure of aluminium and iron by rolling the metals in the cold has been followed röntgenographically in the different stages of the process, the total change in form being investigated by means of face pole figures.

In the case of coarsely-crystalline aluminium foil; the alteration in form consists first in a translation along gliding planes in the sense of Tammann's hypothesis [Abstract 563 (1921)]. When the mechanical treatment becomes more advanced, such translation is followed by a rotation of the crystallites into a definite end-position. Whether the mechanism of this rotation corresponds with that of the bending slip observed by Marck, Polányi and Schmid in the case of the hexagonal metal zinc [see Abstract 991 (1923)] is not clear. These changes are considered from the crystallographic point of view. The ideal end-position of the crystals is masked by a very considerable spreading, which takes place in somewhat different forms in the two metals investigated. T. H. P.

440. *The Speed of Cementation of Copper as a Function of the Temperature.* **T. Peczalski** and **A. Launert.** (Comptes Rendus, 179. pp. 887–890, Nov. 3, 1924.)—The authors have measured the changes in the physical properties of copper cemented by various salts at increasing temperatures. Rods 25 cm. long were placed in iron tubes 12 mm. diam., surrounded by the pulverised dry salts, and the tubes heated in a suitable electric furnace regulated by a thermoelectric pyrometer. The rate of cementation is found to depend on several factors, such as degree of pulverisation of the salt, temperature, and time. From experiments quoted with data for potassium chloride at temperatures in the vicinity of its fusion-point the rate of cementation is practically the same for solid or liquid, and an optimum temperature exists towards 850°. These conclusions are deduced from diameter and density measurements. Data are also included for barium and calcium chlorides. H. H. Ho.

441. *Experiments on the Fatigue of Steel.* **A. Ono.** (Kyushu Univ. Coll. Eng., Mem. 3. No. 2. pp. 51–85, 1924. In English.)—Gives the results of experiments on the effect of heat treatment on a 0·25 carbon steel and on two nickel-chrome steels containing 2·75 Ni, 0·88 Cr and 4·24 Ni, 1·14 Cr respectively. In the case of the fatigue resistance of hardened and tempered specimens it was found that the reheating temperature should be moderate in order to give high figures. The rate of cooling from the reheating temperature influences the fatigue resistance, the quick cooling giving rise to more or less higher resistance than the slow cooling. The effects of rest during the fatigue test and of previous straining in a smaller stress range were found to increase the fatigue resistance. The results of statical and dynamical tests on the specimens reheated to various temperatures are also given, and it is shown that, in the case of ductile materials a crack is developed long before the completion of fracture. C. O. B.

442. *Influence of Substituents on Chemical and Physical Properties: the Velocity of Reaction between Substituted Benzoic Anhydrides and an Aliphatic Alcohol.* **H. G. Rule** and **T. R. Paterson.** (Chem. Soc., J. 124. pp. 2155–2163, Oct., 1924.)—Substitution in an organic compound has been compared to the introduction of an electrical doublet which varies in orientation and strength with the nature of the ingoing group [see J. J. Thomson, Abstract 155 (1924)]. The doublet representing a positive group such as NO_2 or CO_2H is found to be of the opposite orientation to that representing a negative one such as CH_3, OH, or Cl. Further, the change in chemical reactivity following on substitution is traced to the change in the electrical field in and around the molecule. As many properties of compounds are influenced by the electrical state of the molecule, it might be expected that there would be some regularity in the manner in which they are affected by different substituents. Previous work on these lines by Rule, Michael and Oechslin, Kellas, and Olivier is described briefly. In the present investigation the influence of the groups NO_2, Cl, OCH_3, and CH_3 upon the reactivity of benzoic anhydride has been determined, using (*a*) an excess of ethyl alcohol, or (*b*) a molecular proportion of cetyl alcohol in benzene solution. Comparative figures for the substituents CH_3, OCH_3, and H were obtained by the former method, but owing to their high reactivity and low solubility the majority of the nitro- and chloro-derivatives could not be examined in this way, since in presence of the necessarily large excess of alcohol the reaction continued rapidly during analysis. The relative effect of the groups NO_2 and Cl as compared with H is obtained from the rate of reaction of the corresponding compounds with cetyl alcohol in benzene solution. Under the conditions necessitated of high dilution, the methoxy and toluic derivations reacted with extreme slowness, but the change proceeded even more sluggishly in solvents other than hydrocarbons. Contrary to the experience of Michael and Oechslin with the esterification of the free acids, the anhydride reaction was found to be highly sensitive to the influence of substituents. H. H. Ho.

443. *The Reactivity of Coke.* **J. P. Arend** and **J. Wagner** (Rev. de Mét. 21. pp. 585–599, Oct., 1924.)—The reactivity of coke is a property essentially different from the combustibility of coke in air. The reactivity is the measure of the power of the coke to reduce more or less rapidly CO_2 by the reaction : $C + CO_2 = 2CO$. The reactivity depends upon the temperature, and strictly speaking must be measured under conditions of equilibrium. But as in many cases equilibrium is only attained after a considerable period of time the observations are tedious. The present writers define what might be called a dynamic reactivity. They passed CO_2 through a sample of the coke under test at a definite rate and measured the amount of CO produced for different temperatures of the specimen. The following conclusions are reached with regard to the suitability of coke used in blast furnaces. A coke is required which has a small reactivity over the range 500° C. to 1100° C., but which then augments to such an extent that the reactivity at 1500° C. is equal to that of the best cokes used in practice. A coke of the quality indicated may be obtained by the rapid heating of coal to a temperature of 750° C., followed by a slower heating to 1200° C. A. A. D.

444. *Ionisation Constant of Hypochlorous Acid.* **F. G. Soper.** (Chem. Soc., J. 125. pp. 2227–2231, Nov., 1924.)—Noyes and Wilson [Abstract 2473 (1922)] having found for the acidic ionisation constant of the amphoteric hypochlorous acid a value only one-fifth of that of Sand, the author determines this constant by an independent method, estimating the free hypochlorous acid in a solution of sodium hypochlorite by the partition of the acid between the aqueous solution and the vapour above it. A similar method had been used by Neumann and Müller, 1906. The solution is distilled under the reduced pressure of 12 mm. in a glass apparatus immersed in water at 25°. Over the concentration range studied, 10^{-4} to 4×10^{-3} N the ratio of the acid in the distillate to that in the solution proved to be nearly constant, about 2·69, which would support Jakowkin's view that the molecule of the acid $HClO$ is the same in the solution and in its vapour. This view was not shared by Noyes and Wilson, whose calculations are questioned by the author. The acidic constant found is $1 \cdot 0 \times 10^{-8}$. A determination of the very small basic ionisation constant was not attempted. H. B.

445. *Quantitative Separation of Platinum and Iridium.* **S. Aoyama.** (Tôhoku Univ., Sci. Reports, 12. pp. 365–392, July, 1924. In English.)—The complexity and inaccuracy of methods hitherto proposed for the separation of Pt and Ir are referred to in reference to the importance of the availability of a simple and reliable method in the production of thermocouples and standard measures of length and mass, and in exact chemical and physical research. The method described in the present paper is purely chemical, the metals being selectively precipitated from their solutions under prescribed conditions of acidity and concentration by successive treatment with Cu and Mg. A. B. C. L.

446. *Oxidation Potentials.* **S. R. Carter** and **F. H. Clews.** (Chem. Soc., J. 125. pp. 1830–1838, Sept., 1924.)—Oxidation potentials of the ferric and ferrous salts determined in concentrated hydrochloric acid and phosphoric acid respectively. The logarithmic law shown to hold for variations of the ratio of the ferric-ferrous radicals in concentrated acid solution. Increasing concentration of acid causes a decrease in the oxidation-potential in each case, and this is attributed to the formation of complexes. The diffusion-potential is insufficient to account for this change in potential. Potentials plotted against acid concentrations and discussed in the light of the action of SO_2 on ferrous and ferric salts. A. D.

447. *The Ammonia, Carbon, Hydrogen Cyanide, Hydrogen Equilibrium, and the Free Energy of Hydrogen Cyanide.* **R. M. Badger.** (Am. Chem. Soc., J. 46. pp. 2166–2172, Oct., 1924.)—In half of the experiments a mixture of ammonia and nitrogen (used to dilute the ammonia) was passed over a very active heated charcoal, and in the other half hydrogen cyanide was added to the ammonia mixture; hydrogen was not added, as it was supplied by the decomposition of the ammonia. It was not possible to approach equilibrium by starting with mixtures of pure hydrogen cyanide and hydrogen. The numbers of millimoles of H_2, HCN, NH_3 and N_2 were determined by analysis, the H_2 being found by the thermal conductivity method, and the HCN and NH_3 being absorbed in distilled water and titrated; in some of the experiments the HCN was absorbed in soda-lime. The values obtained for $K \times 10^6$ varied between 8·6 and 3·7, for absolute temperatures between 785° and 811°, and pressures from 744 to 747 mm. K is the equilibrium constant. The "constants" are not affected by the direction of approach to equilibrium. Using the available data on the dissociation of ammonia, and the heat data, the free energy F of hydrogen cyanide gas at 800° Å. has been calculated as 28,400 cal., and, at T^0, $F = 30{,}600 + 0 \cdot 60\,T \log T - 0 \cdot 00068T^2 + 0 \cdot 00000011T^3 - 6 \cdot 3T$. This gives 29,700 cal. at 298° Å. Lewis and Randall found 28,911 cal. H. N. A.

448. *On the Velocity of Bimolecular Reactions in Solutions.* **J. A. Christiansen.** (Zeits. phys. Chem. 113. pp. 35–52, Oct. 18, 1924.)—Paragraph one of this paper discusses the works of Brönsted and Bjerrum, the former's expression [see Abstract 1929 (1922)] for the velocity of a bimolecular chemical reaction taking place between two of the ions in a salt solution receiving detailed attention, and the opinion is expressed by the author that Brönsted's expression not merely affords approximate results, but may be of exact validity. Bjerrum's alternative derivation of the kinetic activity factor is then dealt with, following which the author devotes paragraph two to an investigation of the velocity of bimolecular reactions from a somewhat different standpoint from either Brönsted or Bjerrum. This employs the equation $h = \mathrm{C}_1 . \mathrm{C}_2 . v_{12}\sqrt{\mathrm{T}}\, e^{-\phi_{12}/\mathrm{RT}}$, where h denotes the velocity (in mol./litre. per sec.), C_1 and C_2 the molar concentrations of both gases, v_{12} and ϕ_{12} characteristic constants. The impact number S_{12} per sec. is $\mathrm{S}_{12} = \mathrm{C}_1\mathrm{C}_2\mathrm{Z}_{12}\sqrt{\mathrm{T}}$, where Z_{12} is characteristic of the molecules concerned but independent of the concentrations. Z_{12} and v_{12} are found to be of the same order and their relationship is discussed in detail. A new expression is then evolved and tested by data for hydrolysis, *e.g.* of methylacetate, acetanide, etc., exterifications, *e.g.* of acetic acid, and formation of substituted ammonium iodides, *e.g.* by allyl iodide and dimethylaniline. Paragraph three investigates the electrostatic forces in ionic reactions, and determines how the expression found in paragraph two, viz.: $h = \mathrm{C}_1\mathrm{C}_2\mathrm{Z}_{12}\sqrt{\mathrm{T}}\, e^{-\phi_{12}/\mathrm{RL}}\, \Omega\sigma/(\sigma + \Sigma\eta\mathrm{C})$, has to be modified, Ω being the steric factor, σ the velocity of the spontaneous element reaction in the active complex, C the concentrations of the different kinds of molecules, and η a numical coefficient. Paragraph four is devoted to a comparison with Brönsted's formula, and paragraph five with experimental results, general agreement being found. H. H. Ho.

449. *The Relation between the Temperature Coefficient and the Mechanism of a Chemical Reaction.* **F. O. Rice, C. F. Fryling and W. A. Wesolowski.** (Am. Chem. Soc., J. 46. pp. 2405–2418, Nov., 1924.)—The temperature coefficient of a catalytic reaction is shown to be dependent mainly on the nature of the catalyst, and comparatively independent of the nature of the liquid in which the reaction takes place, or substrate, as illustrated in the following table, which shows the effect of adding three different non-electrolytes to the water, in the reaction acetone-iodine-hydrochloric acid; k_{20} is the velocity constant at 20° C., and k_{25} at 25° C.:

	Without Non Electrolyte.	0·511 M Cane Sugar.	1·84 M Methyl Acetate.	0·99 M Acetic Acid.
k_{25}/k_{20}	1·8175	1·8117	1·7995	1·8143
$k_{25} \times 10$	17·1	25·3	17·2	16·9

The values of k_{25}/k_{20} differ only a little, though the differences between those of k_{25} are large. Double compound formation of the substrate with one of the constituents of the solution may affect the temperature coefficient, as there is usually a small heat change; the effect can only be small compared with the effect of a catalyst, which is usually associated with large energy changes. Acid catalysis is attributed to the positively charged hydrogen ion, or "hydrogen protion," and catalysis by alkalies to the "hydroxyl protion." It is assumed that the large temperature coefficients of these reactions are due to certain "residual molecules," which are present in very small concentrations, and are connected with an equilibrium constant in such a way that their concentrations vary rapidly with temperature. For instance, in water the simple water molecules H_2O (hydrol) are present in very small concentration, and are residual molecules; when hydrochloric acid is added to water it is practically entirely dissociated, the H^+ and Cl^- mostly uniting with several molecules of H_2O to form $(H \, . \, aH_2O)^+$ and $(Cl \, . \, bH_2O)^-$; the residual molecules will be HCl, H_2O, H^+ and Cl^-, the concentration of these changing rapidly with the temperature. For a reaction to proceed with measurable speed, at least one of the reactants must be a residual molecule. The existence of slow unimolecular reactions is denied. H. N. A.

450. *Allotropy of the Sesquioxides of Iron, Aluminium, and Chromium.* **G. Chaudron** and **H. Forestier.** (Comptes Rendus, 179. pp. 763–766, Oct. 20, 1924.)—Fe_2O_3, prepared by drying the hydrate obtained by cold precipitation of dilute solutions of the nitrate or chloride, is agglomerated under high pressure into rods which are subjected to heat. At 400° C. a brisk evolution of heat, resulting in incandescence, is observed, together with cracking or splitting of the specimen and a contraction of about 30 %. The transformation is accompanied by changes in the magnetic properties. Similar transformations are noted with Al_2O_3 (at 600° C.) and Cr_2O_3 (at 500° C.). Curves are given showing irregularities in the coefficients of dilatation of various (allotropic) oxides of Fe, the calcined oxides of Al and Cr, however, behaving normally. A. B. C. L.

451. *Explosion of Ammonia with Electrolytic Gas* $(2H_2 + O_2)$ *and with Oxygen.* **J. R. Partington** and **A. J. Prince.** (Chem. Soc., J. 125. pp. 2018–2025, Oct., 1924.)—Mixtures initially at 85° C. and 380 mm., so that no steam could condense. With electrolytic gas (e.-g.) the mixture became explosive when the ratio e.-g./NH_3 was just above 1, 70 % of the ammonia being then decomposed; when the ratio was 2 the decomposition was complete; with still higher ratios there was no reversal of the proportion of decomposition. With oxygen, when NH_3/oxygen $>1 \cdot 66$, the oxygen unites preferentially with the hydrogen of the NH_3, leaving N and excess of hydrogen unburnt; when $<1 \cdot 66$, oxides of nitrogen are formed, the maximum oxidation of nitrogen being 16 % when NH_3/oxygen $= 1 \cdot 22$. The commencement of oxidation of nitrogen is accompanied by a definite change in the appearance of the flame. When mixtures of N_2 and H_2 are exploded with O_2, the amount of nitrogen oxidised is less than when the ammonia which would be formed from these mixtures is exploded with the same ratio of oxygen. A. D.

452. *A Condition for Ensuring Safety with Mining Explosives in an Inflammable Atmosphere.* **E. Audibert.** (Comptes Rendus, 179. pp. 825–827, Oct. 27, 1924.)—It is considered that the detonation of explosives as employed in mining gives, in the first place, a number of gases, such as hydrogen, carbon monoxide, and oxides of nitrogen, which are in a state of unstable equilibrium. The interaction of these gases with the production of heat and flame then follows as a secondary or "residual" reaction. It follows from this sequence that during blasting a violent development of pressure first occurs in the cavity, to be followed by a progressive increase through the residual reaction. If, through the detonation, the cavity is opened up before completion of the residual reaction, the accompanying flame has access to the surrounding atmosphere, which, if of inflammable gases or dust, may lead to ignition. As there is no practical method of checking the occurrence of the residual reaction, the essential condition for safety is to ensure that this reaction is completed before the participating gases reach the outside atmosphere. This condition is ensured in the case of any given explosive by arranging a definite weight of charge and the depth and nature of the cavity. Conclusions which have been inferred from gallery experiments are not considered applicable in mining practice, as the degree of confinement or tamping is not reproduced. A further method of investigation which has been followed, though without practical results, is to suppress either the residual reaction or the subsequent ignition of the inflammable atmosphere by incorporating with the charge, or otherwise introducing, an inert dust, which becomes suspended in the gaseous products of the explosion.

J. N. P.

453. *The Safe Firing of Blasting Charges in an Inflammable Atmosphere.* **E. Audibert.** (Rev. Indust. Minérale. Colliery Guardian, 128. pp. 1251–1252, Nov. 14, and pp. 1374–1375, Nov. 28, 1924.)—It is found that when a high explosive with a combustion temperature below 2200° C. is fired in a fire-damp atmosphere, ignition is always produced if a sufficiently heavy charge is used. It would appear that apart from combustion temperature and the heating due to conductivity, a heating effect is produced by a compression wave which is propagated. By photographing the detonation it is found that ignitions that cannot be explained by the heat due to compression are coincident with the formation of a flame. It is found that explosives composed of ingredients surcharged with oxygen still produce gases capable of giving a flame which has a duration of several thousandths of a second and is capable of igniting fire-damp and coal dust. An investigation of the process of decomposition of solid explosives has led to the conclusion that the reaction proceeds in a series of definite steps, each stage possessing a definite reaction velocity. This confirms the conclusion of Taffanel and Dautriche in 1912 that the hypothesis of an instantaneous and complete reaction in the front of the wave is inadmissible. By conducting the detonation of nitroglycerine in a leaden cylinder, a device is employed to collect the gaseous products after being subjected to sudden and varying degrees of cooling. The quantity of free H_2, CO, N_2O, and O_2 is found to increase with increase in the rate of cooling, from which it is apparent that the transformation of nitroglycerine into gas gives rise not to a completely oxidised system as stated by Berthelot, but to a mixture of reducing and oxidising substances which combine together with a velocity which depends on the conditions of temperature and pressure. The results obtained support the hypothesis that during the passage of the explosion wave oxygen combines partially with nitrogen to form an endothermic compound, the subsequent reduction of which by CO liberates a greater quantity of heat than the combustion of CO to CO_2. The interpretation of the explosive phenomenon seems to be as follows: In a gaseous, liquid, or solid explosive (E), the atoms constituting the molecule may, by combining in different ways, give rise to a certain number (k) of gaseous systems (G). Among the k reactions (E) → (G) the one actually produced by the explosion wave is that which is the most rapid under the prevailing conditions of temperature and pressure and not the one which is most exothermic, an exothermic reaction being subsequently set up by the gaseous system thus formed. When *k* equals unity or when the most rapid reaction is at the same time the most strongly exothermic, no reaction occurs behind the front of the wave. This condition is limited to very simple molecules in which the reaction is particularly violent. J. N. P.

454. *Third Report of the Committee on Contact Catalysis.* **H. S. Taylor.** (J. Phys. Chem. 28. pp. 897–942, Sept., 1924.)—A summary is given of recent investigations dealing with the nature, mechanism and general technique of contact catalysis, the grouping of the matter being under the following headings: wall reactions; catalytic hydrogenation; preferential hydrogenation; dehydrogenation; promoter action; catalytic oxidation and promoter action; relation between extent of adsorption and catalytic activity; adsorption and catalysis; adsorption and the influence of support materials; heats of adsorption; interface phenomena; gas-liquid reaction velocities and catalysis; inhibition phenomena; simultaneous action of catalysts and radiation; poisons; co-actions and the mechanism of reduction. The report does not lend itself to abstraction. T. H. P.

455. *Volumetric Estimation of Total Carbonic Acid in Dilute Solutions of Calcium Hydrogen Carbonate or in Hard Tap-waters.* **E. M. Crowther** and **W. S. Martin.** (Chem. Soc., J. 125. pp. 1937–1939, Sept., 1924.) —The estimation of carbonic acid by precipitation with lime and calcium chloride is rendered more rapid and accurate by the addition of a small amount of solid calcium carbonate to provide nuclei for the precipitation of this compound from the solution. T. M. L.

456. *Studies in Contact Electricity. The Charge of Metals with Respect to Dielectrics.* **A. Cohen** and **A. Curs.** (Zeits. f. Physik, 29. 5. pp. 186–195, 1924.)—The Volta effect and the charge with respect to dielectrics in high vacua is here considered, and found to depend (*a*) on the nature of the metal and its position in the potential series, *i.e.* its tendency to split off electrons; (*b*) on the nature of the dielectric with regard to its acceptance capacity for positive metallic ions. The charges on glass and quartz against other dielectrics are then investigated. Mercury and the amalgams of the noble metals are found to be charged positive with respect to all the dielectrics employed, *viz.* diamond, quartz, flint glass, radium glass, ebonite, sealing-wax, and amber. The amalgams of other metals, however, such as zinc, cadmium, tin, lead, etc., at certain concentrations are negative, and concentrations affording reversibility are established. Towards diamond the amalgams of the alkali metals at all concentrations are charged positive, and a method has been developed which renders possible the study of contact electricity phenomena at the diamond. Data are given showing the dependence of the magnitude of the charge on the height of the vacuum. H. H. Ho.

457. *Application of the Phase Rule to Galvanic Cells.* **J. A. Beattie.** (Am. Chem. Soc., J. 46. pp. 2211–2223, Oct., 1924.)—It is shown that the phase rule can be deduced for any system in equilibrium. The author proceeds to deduce the phase rule for galvanic cells when in equilibrium, and applies the result to several cells. The paper is not suitable for abstracting, and the original must be consulted. F. J. B.

458. *Seat of E.M.F. in a Galvanic Cell.* **J. A. V. Butler.** (Phil. Mag. 48. pp. 927–935, Nov., 1924.)—The author shows that the existence of large metal contact p.d.'s is in no way inconsistent with the correspondence between the e.m.f. of a galvanic cell and the energy of the chemical reaction occurring therein. The statistical expressions deduced in previous papers [see Abstract 3053 (1924)] for the different conjunctions are coordinated, and a theory of a typical galvanic cell is outlined which includes as different aspects of the whole truth (1) the metal contact p.d. theory; (2) the "chemical" theory; (3) the Nernst theory of metal electrode p.d.'s; (4) the relation between the e.m.f. and total energy change expressed in the Gibbs-Helmholtz equation. G. W. DE T.

459. *Electrolytic Separation of Copper, Antimony, Lead, and Tin.* **A. Lassieur.** (Comptes Rendus, 179. pp. 827–829, Oct. 27, 1924.)—The separation of lead from tin is brought about from a solution containing 20 c.c. conc. hydrochloric acid, 5 c.c. conc. hydrofluoric acid, and 1 grm. hydroxylamine hydrochloride in 225 c.c. solution. By an apparatus described in Abstract 241 (1925) the lead is separated by the application of an auxiliary potential of 400 millivolts, while stannic salts form a complex fluoride from which the tin is not separated. Prior to the electrolysis the solution is boiled with hydrogen peroxide to ensure the tin being in the stannic condition. During the first ten minutes of the electrolysis the temperature of the solution is kept not below 60° C. and subsequently lowered to 20° C. The tin is eventually deposited on a copper-coated kathode after adding to the solution boric acid and ammonium oxalate and applying an auxiliary potential of 600–650 millivolts. The separation of copper and antimony from lead is conducted as previously described. J. N. P.

460. *Electrolytic Introduction of Alkyl Groups.* **J. M. Nelson** and **A. M. Collins.** (Am. Chem. Soc., J. 46. pp. 2256–2267, Oct., 1924.)—The cell employed in most of the electrolyses described in the present paper is of annular form with a porous asbestos diaphragm separating the anode, of thick sheet Cu or Pb, from the cathode, of thin sheet Cu or Cu gauze. Owing to the oxidisable character of some of the substances experimented upon (*e.g.* benzaldehyde), arrangements are made for working in an atmosphere of N. The current is maintained at 0·5 amp. over about two days, a p.d. of 15–30 volts being usually necessary. Immediately after the cessation of the current a back e.m.f. of about 1 volt is observed, decreasing nearly to zero in a few minutes. The cell is charged with benzaldehyde containing ethyl iodide and triethylamine, the latter pair at first interacting to form tetra-ethyl-ammonium iodide, after which the electrolysis is started. One of the products is the ethyl ether of ethylphenyl carbinol, never before prepared. The reaction by which this compound is formed, involving the electrolytic introduction of two ethyl groups into the benzaldehyde molecule, is discussed and its analogy with the Grignard reaction and with ordinary reduction reactions is pointed out. Similar behaviour of the corresponding methyl derivatives is indicated. A. B. C. L.

461. *An Apparatus for Separating Albumin from Globulin.* **A. Brossa.** (Accad. Sci. Torino, Atti, 59. 14. pp. 323–329, 1923–1924.)—With this apparatus albumin is separated from globulin by electric osmosis. It consists essentially of three open glass tubes united to form the letter

Y, of which one branch is vertical; the other two branches are closed by diaphragms and dip into two beakers each containing distilled water and a metallic electrode. The Y-tube contains the liquid to be examined, which is kept in a state of continuous though small movement by a current of air. The distilled water must flow continuously. The current is regulated so that in about 30 seconds the electrolytes almost completely disappear, after which the albumin remains in solution and the globulin is precipitated. Only 2 to 3 c.c. of liquid are required in the apparatus.
E. B.

462. *Studies of Electrolytic Polarisation. Part I. Kathodic Overvoltage of Lead.* **S. Glasstone.** (Chem. Soc., J. 125. pp. 2414–2423, Nov., 1924.)—Extending previous work [Abstracts 1633 and 2643 (1924)] to measurements at varying hydrogen-ion concentrations in various electrolytes (sulphuric acid, caustic soda, alkali salts) and to the determination of the minimum overvoltage at which bubble formation is observed, the author first roughens his bright lead electrode as kathode in sulphuric acid and then places the kathode in the respective electrolyte at room temperature, increasing the polarising current until bubbles appear and then decreasing the current again. The potentials are directly determined with low current densities; at higher current densities the commutator method of the author is used, the polarising current being cut off for one-sixth of a cycle. The author finds that the second term of the usual formula $E = a + b \log I$ should be written $a + b \log (I - c)$, where E = overvoltage, I current and a, b, c constants, because electromotively-active material is removed from the electrode by diffusion. Calculated and observed values are then in excellent agreement. The c is small except at high current density. At appreciable values of I the kathodic potential of the electrode is influenced by the alkali-metal ion, but the overvoltage is little affected. The supersaturation with gas of the kathode (Thiel and Breuning) is found to be unimportant. The minimum overvoltage at a bright lead electrode is 0·67 volt in sulphuric acid and 0·55 in alkali; at the roughened electrode it is 0·62 and 0·48 volt.
H. B.

463. *The Preparation of Fluorine.* **J. Simons.** (Am. Chem. Soc., J. 46. pp. 2175–2179, Oct., 1924.)—The extremely electro-negative character of fluorine has been little investigated owing to the difficulty of its preparation in large quantities. The present method is an improvement of the fluorine generator of Argo, Mathers, Humiston and Anderson, and develops the technique for the regeneration of the electrolyte and the continuous generation of large quantities of fluorine. Argo, Mathers, Humiston and Anderson [see Abstract 1262 (1919)]. The method consists in the electrolysis of fused potassium acid fluoride in a cell which consists of an electrically heated copper vessel which serves as kathode and electrolyte container. The present experiments developed means for eliminating the difficulties hitherto encountered, namely: (1) The obstruction of the delivery tube by foam arising from the bath; (2) the regeneration of the electrolyte; (3) after running some time the anode became short-circuited to the diaphragm through the insulating seal. The overcoming of these difficulties is described in a detailed account of the type of electrolytic cell used.
S. G. B.